EDITORIAL

As he reads through published reports of scientific developments during 1958, every thinking man must be staggered by their rapidity and scope.

Only about 15 months ago the first earth satellite was elevated by the Russians. It marked the starting point for a programme of practical research unequalled in modern times.

But although 1958 was spectacular, its achievements are only a prelude to what will happen in 1959 and in the years to come. Scientists and engineers are only just mastering the elementary tools of their trade.

From now on these will be improved and refined until the problem of transporting vehicles into the unknown will become commonplace when compared with the results of their journeys through space.

I do not feel as yet that we have appreciated the changes which the space age will bring to our conventional philosophies and channels of thought. We have first to overcome the sense of detachment with which most people, quite understandably, view all these great happenings. It is still hard to realise that we are speaking of immediate matters, and not an extension of the fantastic stories we pored over years ago, for the ultimate realisation of the fact will be far more wonderful than the creations of fiction.

Last year we watched satellites moving across the visible sky. Now we have two of them which have gone so far beyond the earth as to encircle the sun itself.

Set down for an early date is a vehicle which will send human beings into orbit, so confident are engineers of their increasing skill.

Still more important is a proposal that an aircraft—if we can call it that—containing a pilot will be sent into space, re-enter the atmosphere, and return to base.

These would be the greatest achievements to date, immeasureably more valuable than the use of electronically packed machines guided from the ground. One man is worth half-a-ton of electronics, and can perform functions beyond the scope of any reasonable machine.

Although the actual doing of these things is wonderful enough, even more wonderful will be the knowledge we will gain when finally we are able to extend our horizons far beyond our own planet. And it seems to me that the challenge such information and widened outlook will bring to our beliefs about the universe will be just as profound in its implications and its scope.

At all costs we must not turn away from it. I wonder how well equipped we are to accept what we will learn?

John Moyle

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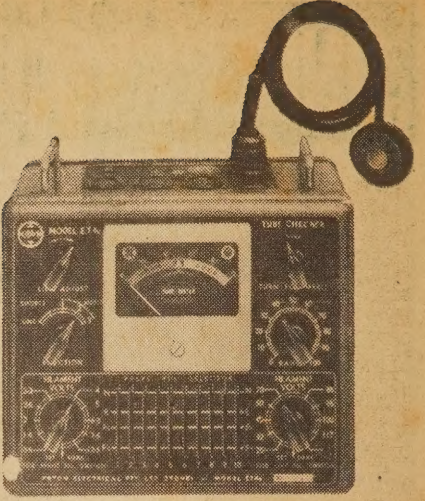

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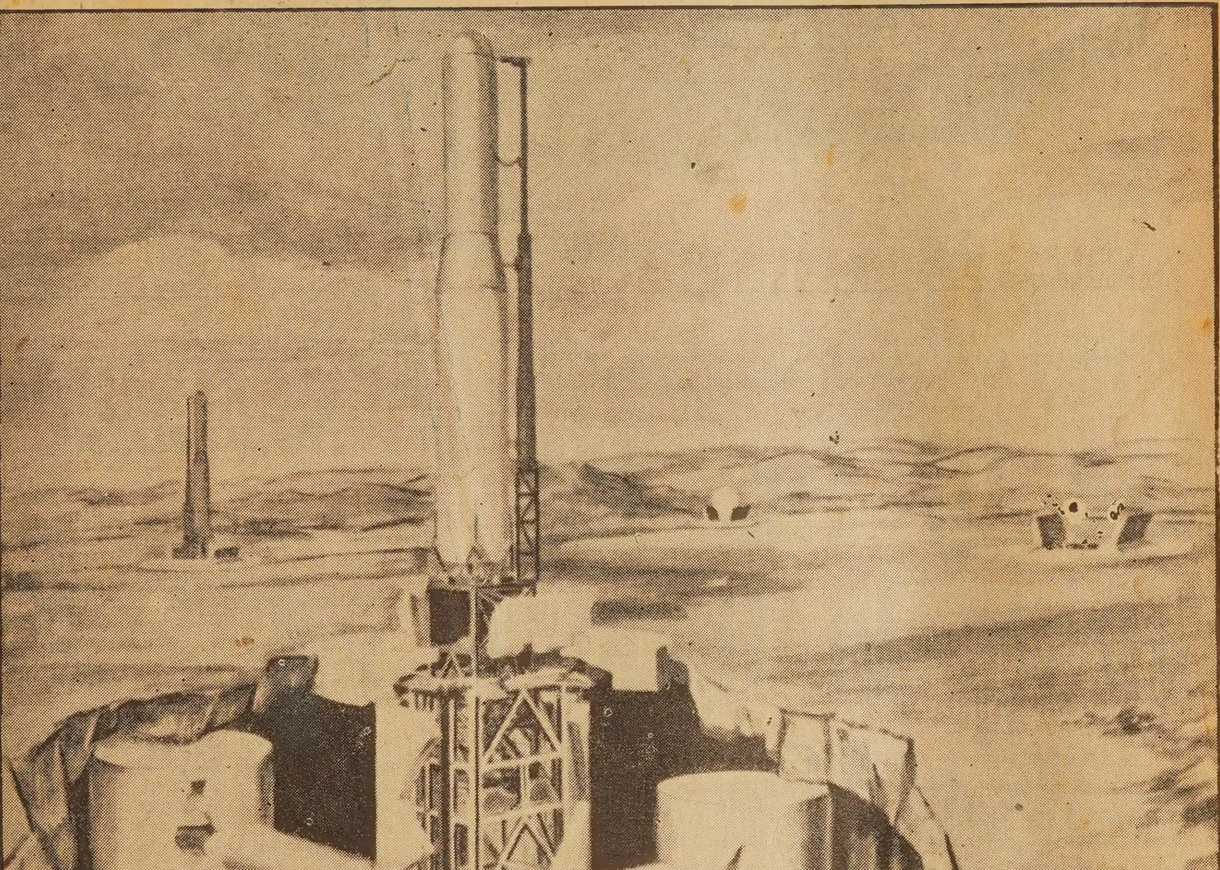
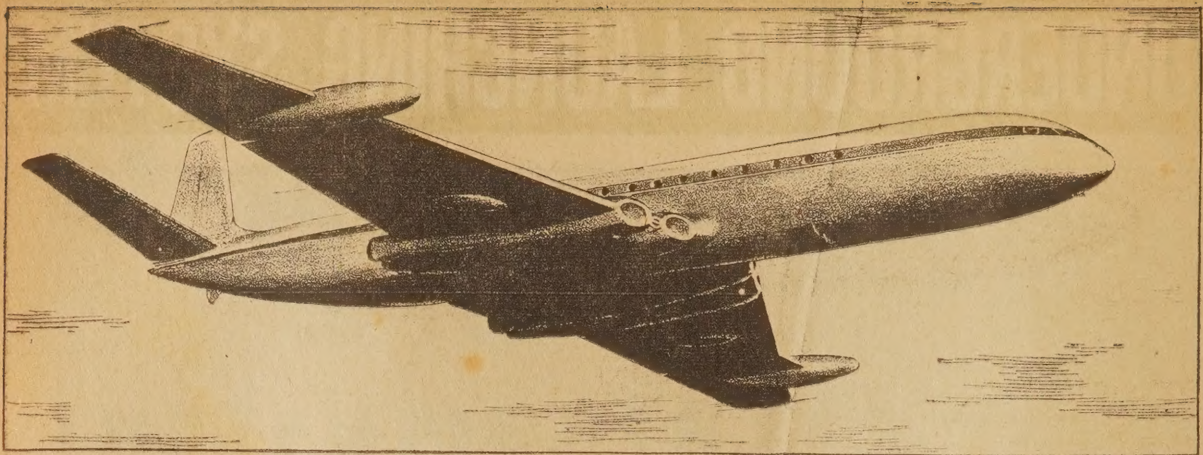
UNDERGROUND LAUNCHING SYSTEM



This artist's drawing, released recently by the American Machine & Foundry Co., reveals the underground launching system for the Air Force's intercontinental ballistic missile, the Titan, now under development. The huge missile will rest on an elevator inside the underground steel framework and, when it is ready for launching, will be raised to ground level. In the underground blockhouses will be the firing control mechanism and a station for receiving telemetry data from the missile. The launching complex, now under construction at Vandenberg Air Force Base near Lompoc, Calif. will be used for military firings as well as for research and development work. The new system eliminates the overhead gantry so familiar at Cape Canaveral, Fla.



Britain's Comet IV, the first jetliner to span the Atlantic with a revenue load (for BOAC). It carries 81 passengers. The makers, De Havilland, quote 500 m.p.h. as its speed "with schedule flexibility to match traffic on stages up to 3,000 miles" and 545 m.p.h. with "big payloads over short and medium route sections."

Age Of The Jet Bursts In Upon Us

By R. Michel

☆

A new age in commercial air transportation has opened with the introduction of jetliners on the North Atlantic—the biggest and fastest passenger aircraft yet flown. With their high scream, thunderous blast of jet exhausts and rakishly swept-back wings, these new planes have slashed open an era in which the earth's surface, matched against air travel times, has suddenly shrunk to 60 per cent. of its former size.

THE jets fly nearly twice as fast as piston-engined planes. Because of their speed combined with passenger-carrying capacity, each of the new planes is capable of carrying as many people between North America and Europe in a year as is a vast liner like the Queen Mary.

For Australia, the long-awaited introduction of the sleek new air monsters on our inter-continental routes will have special significance. The remaining vestiges of traditional isolation will be swept away when the first of the giant new aircraft roars in from the world's great centres of population.

This jet revolution will represent the third major landmark in civil aviation in less than 25 years.

The first, in the mid-1930s, was the advent of the great work-horse of the air, the Douglas DC-3, which brought wholly new standards of safety and reliability to the airlines of the world.

The second, at the end of World War II, was the use of the powerful long-range aircraft developed during the war to open up regular trans-ocean services with land-based planes.

The third, now upon us, destined to work a revolution in speed, is the substitution of jet engines for the piston engines that have for so long been the power plants of civil aviation.

Ever since the Wright brothers' epoch-making flight at Kittyhawk in 1903, progress has been evolutionary, with steady growth in the size, speed, and range of aircraft. All this evolutionary process has been swept aside by the emergence of jet planes with 40 times the power of their immediate predecessors.

Jet liners designed for various operating conditions are beginning to appear in volume. The new aircraft have been built for the high-speed, high-altitude flight which the new power plants make possible—and, in fact, demand. Long-distance flights are at altitudes between 25,000 and 40,000 feet. In the thin air at these levels, the jets benefit from the lowered air resistance.

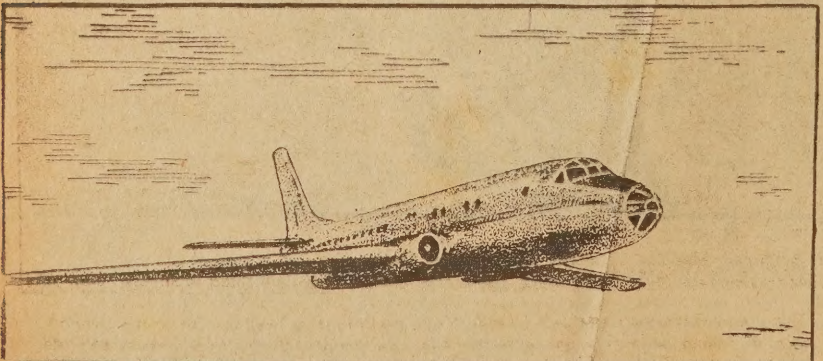
NEARLY VIBRATIONLESS

The jets fly ahead of their engine noise, and so hi-fi music will be a practical background. They are so free from vibration that there is virtually no sensation of movement.

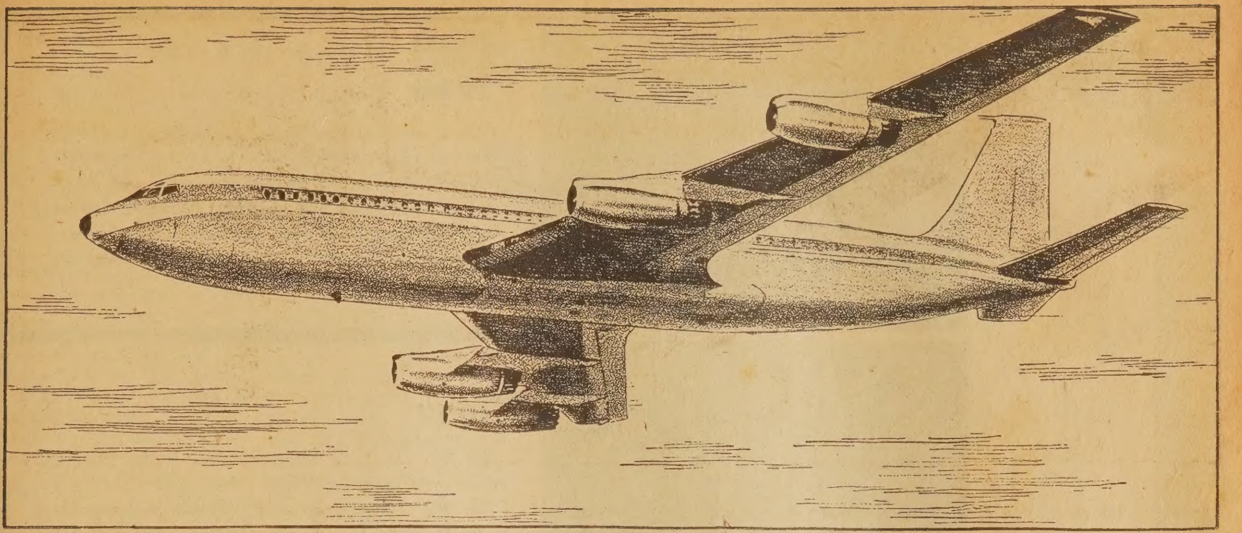
Ground facilities will be stepped up to meet the new levels of service in the air. Operators will provide for passengers to wait for their jet liners in sound-proof lounges, and then board the aircraft on a single level through telescopic, covered passageways leading directly to the plane's two doors.

In the United States, ticketing is already being speeded up with an electronic system transmitting details of booking on every flight and showing which seats are free at any moment.

New operating factors mean that new techniques of scheduling and planning flights must be introduced. New problems in handling air traffic, especially around big terminals, will come in the train of the jets—and these possibilities are already receiving attention.



The Soviet Union's Tupolev TU-104, which carries 70 passengers. The twin-jet airliner is operating on schedules of Aeroflot, including London-Moscow and Brussels-Moscow.



The Boeing 707 Stratoliner, first U.S. commercial jetliner, and the largest and fastest jet in the world. The first of these huge aircraft rolled from the plant in October, 1957, and after completion of flight testing, was delivered to Pan-American Airways. This type of aircraft is now used on the North Atlantic run, making the crossing between New York and London in less than seven hours. Hundreds are now on order by world airlines, including seven for Qantas (which are to be delivered between May and September). Overall length is 144ft and the plane can carry 165 passengers at 575 m.p.h.

All these changes stem from the new factor of jet propulsion—or, as it might be more accurately termed, reaction propulsion, since it is actually the reaction to the jet that produces motion.

The principle on which it operates is most simply demonstrated by an inflated toy balloon. As long as the neck is held closed, the internal pressures are equal in all directions; but when the neck is released the resulting unbalance of internal pressures resulting from the discharge of air produces a force which drives the balloon in the direction opposite to that of the discharge at the neck.

To produce jet propulsion, a mass of fluid must be accelerated through an engine and discharged through a suitable nozzle. In the process, the fluid's momentum is increased and this produces a force. In the gas turbine (or "turbojet") engine adopted for jet propulsion, the jet is the product of combustion plus additional air resulting from burning fuel in the presence of a moving air-stream.

The thrust of jet propulsion is produced and used inside the system. Once the jet is discharged it is of no further use in producing thrust. It does not push against the atmosphere to produce thrust—in fact, the lower this atmospheric pressure existing outside the jet the more efficiently the jet operates.

From a scientific curiosity, the turbojet engine has grown in 20 years to be a prime mover for many types of aircraft where speed is a primary consideration. Its overall advantage is that it produces a very high thrust for a relatively light weight within small envelope dimensions.

New as jets are in civil aviation, jet-propelled flight has a background of intensive research and massive experience. Most of this experience has been in the military field, where inhibiting factors related to economy in operation were of little significance when matched against the need for supremacy in other operational matters. In addition, some British De Havilland Comets were operated for a time in scheduled airline service some years ago, and a new model Comet opened the Atlantic service in November last. More recently, many British-built "turboprops" using gas turbine engines to spin conventional propellers have been in service on airlines in many countries, including Australia.

The "pure" jet gives a great edge in speed over the turboprop—600 versus 400 miles an hour.

Now jet-age passengers will become heir to fast, comfortable and safe travel made possible by years of behind-the-scenes planning.

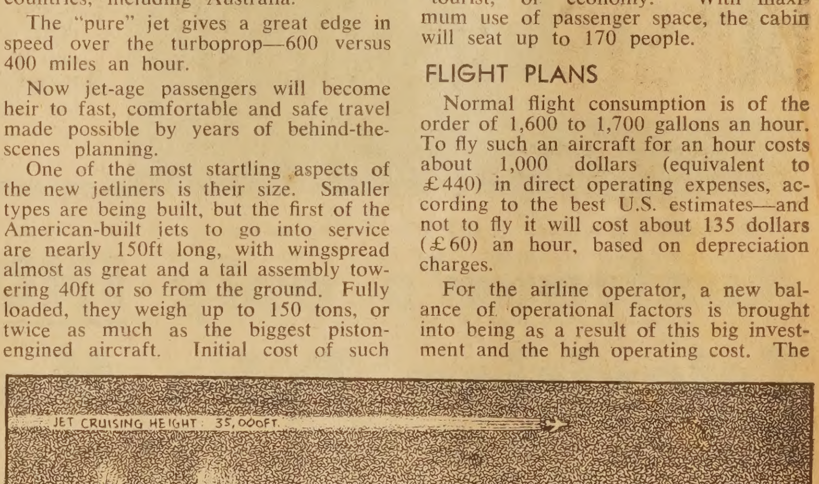
One of the most startling aspects of the new jetliners is their size. Smaller types are being built, but the first of the American-built jets to go into service are nearly 150ft long, with wingspread almost as great and a tail assembly towering 40ft or so from the ground. Fully loaded, they weigh up to 150 tons, or twice as much as the biggest piston-engined aircraft. Initial cost of such planes is more tthan 5,000,000 dollars each.

How many passengers the jetliners carry depends on the class of service being offered — "luxury," "first-class," "tourist," or "economy." With maximum use of passenger space, the cabin will seat up to 170 people.

FLIGHT PLANS

Normal flight consumption is of the order of 1,600 to 1,700 gallons an hour. To fly such an aircraft for an hour costs about 1,000 dollars (equivalent to £440) in direct operating expenses, according to the best U.S. estimates—and not to fly it will cost about 135 dollars (£60) an hour, based on depreciation charges.

For the airline operator, a new balance of operational factors is brought into being as a result of this big investment and the high operating cost. The



This diagram-sketch is adapted from a chart prepared for Boeing to show the relationship of Boeing jetliners' flight level to clouds and weather zone. The cruising altitude of the Boeing 707 is 35,000 feet, while pressurisation gives a cabin altitude equivalent to 5,500 feet. At the heights at which the Boeing operates there is no atmospheric disturbance.

1ST.

1956

Thomas was the first Company to produce a 21-inch picture tube in Australia. It was a 90-degree aluminised tube with electrostatic focus, incorporating a "bent" gun and ion trap. Public acceptance of the larger picture soon established 21-inch tubes as the most preferred size in all makes of receivers.

1957

The first short-neck 90-degree tubes in this country were introduced by Thomas. These tubes feature a "straight" gun and the saving in length has enabled manufacturers to produce slimmer, more compact cabinets. This new design eliminates the need for ion traps and variable ion trap adjustments.

1958

The most sensational advance in Australian television is another Thomas "first"—the flat-cushion, 110-degree picture tube, now being extensively used in super-slim television receivers.

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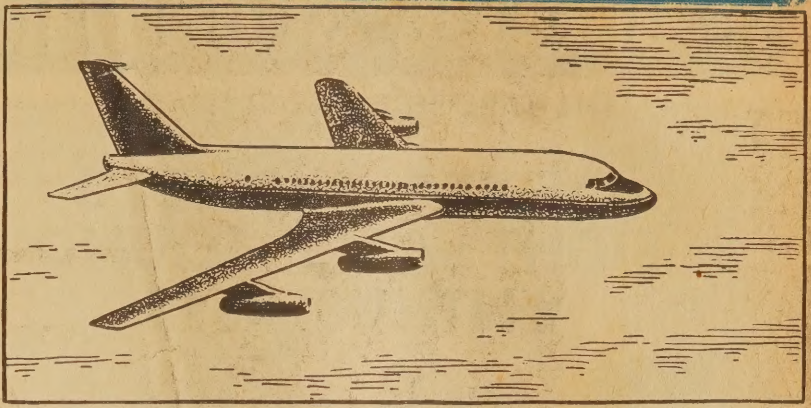
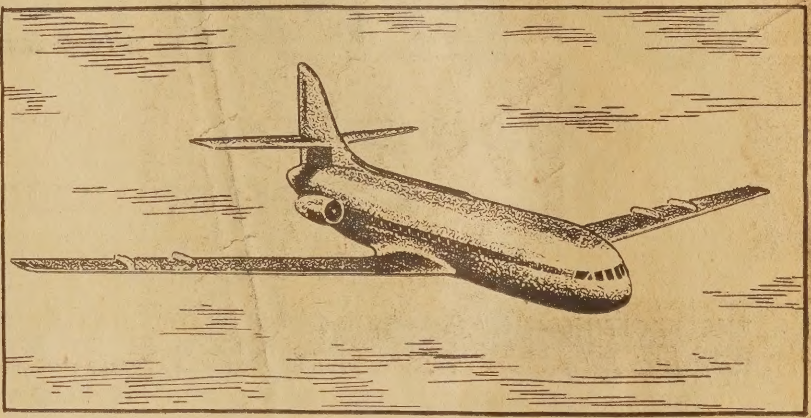


The Convair 880, an American four-engined jetliner, which will accommodate 84 first-class passengers or 114 tourist class, has been designed for versatility. Cruising speed is over 600 m.p.h. and the plane is said to be suited to flights ranging from 300 to 3,000 miles non-stop. Deliveries of production models to the airlines are scheduled for 1960.



Sud Aviation's twin-jet Caravelle, a French design which is the world's first medium-range jetliner. Cruising at 500 m.p.h., the Caravelle can carry up to 80 passengers, Range is 2,200 miles and cruising height up to 40,000 feet. The engines are mounted aft of the passenger cabin. First deliveries of the Caravelle are to be made in October.

evaluating process actually begins when the airline orders ths aircraft, for it then has to choose among engine models of varying power.

At first glance, the choice would seem easy: the biggest engines which could possibly be used would not increase speed very much, while the lower-powered engines cost less. Yet, that is not the full story.

What the more powerful engines can do is to make it possible to take off with a big load under less favourable conditions—such as a rather short runway, hot weather, and high-altitude airport. The thinner air produced by heat or altitude makes it harder for an aircraft to take off, and as jets accelerate sluggishly, the new planes require either higher-powered engines or a very long runway to build up speed. If neither is available the load must be reduced, and less payload means less revenue.

Estimates must be made on how often this kind of situation is likely to arise, so that a sound decision can be taken on the type of engines which will be truly most economical.

FLYING COSTS

To keep fuel consumption at optimum levels, flight plans must be calculated carefully. The most economical way of reaching the high cruising altitude is the "drift up," a long, gentle climb during which the aircraft may travel 500 miles or more. The most economical way of descending at the end of a flight is a rapid letdown and prompt landing.

Any departure from these procedures exacts a penalty in the form of added fuel consumption.

Yet the most desirable flight patterns will not always be possible. Two reasons particularly will operate against it.

Sometimes the jet will have to climb quite steeply away from airports in order to avoid low-level flights over nearby communities because of external noise. Noise suppressors are steadily being improved, but jets are not yet quiet machines.

Further, the drift-up technique will often be ruled out because of its interference with other airways traffic.

On the let-down, the procedure will in fact be dictated by the traffic situation existing at the particular time and place, and it is clear that the problem of congestion around airports, already a serious one, will be intensified as more and more jets come into operation.

NEED ROOM

One reason is that the jets need so much room. A jet flying a two-minute holding pattern at 30,000ft, for instance, needs 1,250 square miles of unobstructed air (unobstructed, that is, at the 30,000ft level). A jet descending from 20,000ft needs a flight path 40 miles long to come in to land.

If a jet is delayed in landing it would probably prefer to do its waiting somewhere about 20,000ft to avoid higher fuel consumption rates incurred at lower altitude. On the other hand, if a predicted delay of 30 minutes at 20,000ft could be reduced to 20 minutes by use of lower levels, there would be a gain in coming down.

The stacking problems will place new strains on air traffic controllers. Not only will more controllers be needed, but new mechanical aids must be introduced to take over some of the work and to reduce the amount of information that has to be passed verbally between ground and air. Aids include electronic data-processing machines on one hand, and improved radars on the other.

Before take-off, jets involve extra work on the part of airport controllers. When idling, a jet engine uses up fuel at a rate almost as great as at cruising speed, and so the jet plane cannot afford much delay at the end of a runway waiting for other departing or inbound planes. The control tower must see to it that once the jet engines are started the plane can move promptly to its runway and get going.

Where take-off conditions indicate its usefulness, the so-called "water augmentation" (or "wet engines") process will be used. This is a way of boosting power by about one-third for take-off, and its value is in overcoming problems of a short runway, or high altitude, or high air temperature.

Fed into both the engine's air intakes, ahead of the combustion chamber, and the combustors, the water is consumed at a great rate—and the entire quantity of 700 gallons or so of engine water is fed in during a minute on the take-off run and immediately after.

Benefits are twofold. First, the water lowers the temperature of the air (which has been raised by compression), and as a result more fuel can be fed into the combustion chamber without exceeding the maximum permissible temperature at critical points. Second, because the thrust is directly related to the weight of air passing through the engine, the higher density of water-cooled air enables the engine to develop more power.

LUBRICATING OILS

Lubricating oils for jet engines must meet peculiarly exacting requirements. Lubricants must remain fluid at a temperature of —65 degrees Fahr., yet be stable and not too volatile at 450 degrees and over, while maintaining their value in relation to corrosiveness and load-carrying ability.

Such lubricants have not come from petroleum. Instead they are synthetic chemical products built around sebabic acid. The cost of manufacture is very high but only relatively small quantities are used—a few quarts for a long flight.

When it comes to fuel, the story is a different one—and the engines have gargantuan appetites. Whereas the largest piston-engined aircraft load about 7,000 gallons of gasoline, the big jets can take from 16,000 to 20.000 gallons (depending on aircraft model) of jet fuel This

(Continued on page 27)

MAGNETIC SOUND INDUSTRIES

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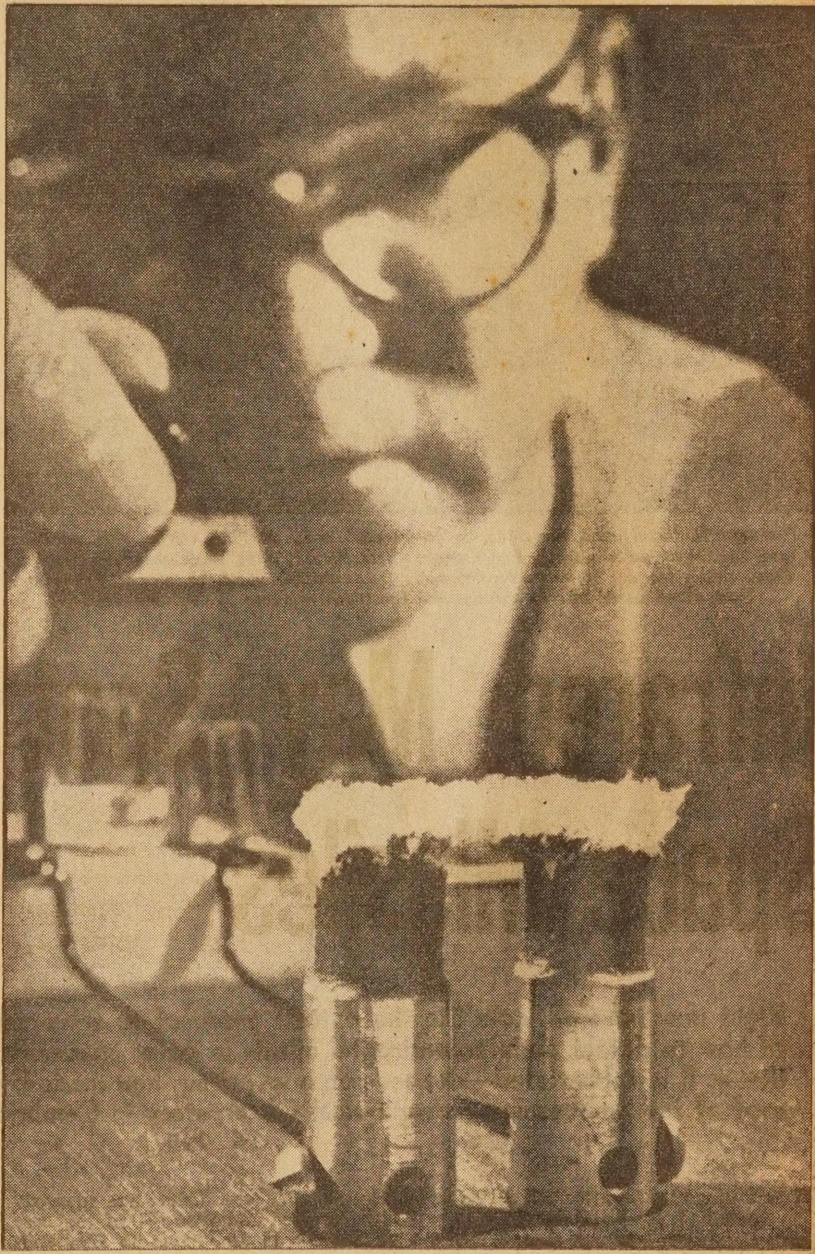
SEMI-CONDUCTORS PROVIDE EITHER HEAT OR COLD

Heating and cooling devices which operate directly by the passage of an electric current, and with no moving parts, are coming nearer with the successful application of semi-conductors. It is even possible that practical devices will be on sale within the next twelve months.



Frost covered crystals (block cylinders) reverse to heat when Westinghouse project engineer flips a switch. Batteries of crystals are used in appliances scheduled for production next year.

THEY are developments of the simple principle of the thermo-couple, by which the passage of current through the junction of two metals or other suitable elements will increase the temperature of one and decrease that of the other.

A reversal of current through the junction also reverses the heat action between the two elements.

This is known as the Peltier effect, so named after its discoverer, Jean Charles Peltier, a French experimenter, about 125 years ago. Until recently the changes in temperature involved have been too small for anything but minor applications in practice.

In recent years, research workers have applied the principle to special cases, and have succeeded in greatly increasing the efficiency and usefulness of their results.

SEMI-CONDUCTORS.

The latest development uses semi-conductors in place of metals with which the effect was originally noticed. These have very greatly reduced the tendency for heat to be conducted to and from the cold and hot ends of the system which is almost inescapable with metals, and have allowed a much greater heat change for a given amount of current.

Many firms have been experimenters in the field. More than two years ago, R.C.A. of America displayed a refrigerator at their Research Laboratory in Princeton, which worked on the thermoelement principle.

Now Westinghouse has apparently developed a material efficient enough for them to talk about using it in commercial designs.

One invaluable characteristic of the thermoelement is its reversability. This enables it to be used for a device which either cools or heats. One can imagine a cool box which can also be used as a hot box in cold weather. Larger sheet elements might heat a house in winter and cool it in summer, merely by operating a current reversing switch.

Once a reasonable degree of efficiency is achieved, all kinds of applications can be forecast, but so far even Westinghouse are not talking about useful refrigeration with large or heavy-duty units.

But it is certain that development will not stay where it is.

Just as the application of current through the element will raise and lower temperature, so the application of heat will produce a current from the elements. Enough progress has been made in this field to operate small items such as radio receivers from power obtained in this way.

One can imagine units specifically designed to make some use of heat generated in engines, for instance, and which is now wasted. A thermoelement could be used to recover some of this heat as electricity to be used for ignition or other purpose.

At any rate the intriguing possibilities of a compact device which produces either heat or cold directly from electricity with no mechanical assistance is sufficient to guarantee spectacular results in the future.

Photographs taken using film sensitive to infrared have startling clarity even when hazy conditions make ordinary films useless. This picture, taken from near Parramatta, shows detail far out to sea when normally the coastline would be almost invisible. Note cloud banks on the horizon, and the black response of the cold water.

Infrared May Spot Space Missiles

Right now infrared looks like the hottest prospect to solve the exceedingly tough problem of how to detect an intercontinental missile in outer space. Part of this new importance of IR—as it is abbreviated—depends on a surprising find made by physicist Myron Block on the roof of the Smithsonian Astrophysical Observatory in Cambridge, Mass., the night of Oct. 14, 1957.

By
GEORGE R. PRICE

IT was just 10 days after the advent of Sputnik I, and Block, head of a small Cambridge research firm, had hastily cobbled together a special IR detection system. Could he detect the satellite by means of its infrared emission even while it was in the darkness of the earth's shadow? There was a bare chance this would be possible.

To his astonishment, he found that the satellite not only was detectable, but that it was emitting more than 10 times as much IR as he had expected — as much as if it were at the temperature of molten lead. And yet it couldn't be very hot or the radio equipment transmitting the "beep beep" wouldn't work.

What could this mean? Block repeated his measurements many times on Sputnik I and some of the later satellites, and he kept finding the strangely high infrared radiation — in the case of Sputnik II amounting to thousands of watts. His present theory: It's related to ions and electrons present in space that combine on the surface of the satellites.

This finding, if borne out, changes the whole picture of missile detection. Previously it was thought that IR would be useful in detecting nose cones heated white hot from atmospheric friction in re-entry, but IR did not look promising for detecting a missile in outer space. Now Block's discovery suggests that an IR detector unit costing a few thousand dollars may be able to detect an ICBM as far away as a radar station, costing hundreds of thousands, could.

When this work was reported in the newspapers, however, there was no big rush to start building an anti-missile IR network. The trouble: The reports simply didn't seem believable. Where could the energy be coming from: It wasn't until Explorer I was orbited last February U.S. scientists learned that there are zones of high-energy particles surrounding the earth

Furthermore, Block's modest organisation — with just a cluttered lab. and workshop occupying the first floor of an old wooden house — didn't seem the sort of place from which such an important discovery could come. If it had been one of the big companies things would have been different. Pentagon officials were sceptical.

RESULTS CONFIRMED

Acceptance may be on the way, however. According to the highly respected IR expert, Mr John Howard, head of the Infrared Techniques Branch of the Air Force Cambridge Research Centre, there have been recent confirmations of Block's findings both in the U.S. and England, and the evidence looks impressive.

However, some very recent British work suggests that under some conditions the extra-high IR radiation may be absent. Possibly, for example, when a satellite or missile is at certain altitudes, it finds few charged particles in space, and so glows only with the comparatively weak radiation that it emits because of its surface temperature. Hence, IR networks would supplement radar, not replace it.

Advantages of IR over radar for missile detection are:

- IR equipment is much smaller, lighter, cheaper and simpler.
- IR gives more accurate information about shape and direction of an object. Thus the Sidewinder air-to-air missile, using IR guidance, can knock a flare off the wingtip of a plane without touching the wing—a feat impossible with radar.
- IR systems are much more difficult to jam or confuse by other countermeasures.
- IR should be better at great distance because the radiation has to go only half as far as radar: from the missile to the IR unit, instead of from a radar station to the missile and back.

Disadvantages are:

- IR penetrates clouds, mist and rain much less effectively than radar.
- IR doesn't give information about the distance and speed of an object in the simple, accurate way that radar does.

There is a long list of possible uses. Vitally important as missile detection is, it is still only the first in an extensive list of likely future uses for infrared. These range from a secret method of lie-detection to new types of radiant heating methods.

At large, important group of applications depends on taking pictures with special "cameras" sensitive in the **far infrared.** These pictures show temperature, temperature shows heat, and heat means energy. Whenever something is happening, energy is involved and heat is likely to be produced. So the pictures reveal action and energy, instead of merely showing how much light the surface of an object reflects.

For example, the picture of a car shows the heat of engine and exhaust. The handprint on the wall shows that someone's hand—alive and warm—was pressed against the wall and transferred heat to it.

The portrait of the man with the pipe shows that the pipe is lit and the man is alive.

Consider three important uses for such pictures.

Medical diagnosis: It's quite likely that 10 years from now, if equipment comes down enough in cost, an IR picture will be a routine part of every medical examination. It will be a quick way to show the doctor areas of poor circulation, inflammation or unusual metabolic activity.

MEDICAL USE

One particularly important medical use of heat pictures is in cancer detection. Dr Ray Lawson, of McGill University, in Montreal, has found that malignant tumours — because of their generous blood supply and high growth rate — are usually a little warmer than the surrounding normal tissue. If the tumour is close to the body surface, this small temperature difference can be detected by an infrared camera. It is easy to foresee mass programs of screening people for breast cancer or other cancer not too deeply buried in the body.

And we can imagine the army of the future with men lined up side by side for examination, and an IR instrument sweeping from one to the next, to take a whole battalion's temperature in half a minute!

Vision in the dark by far IR: Infrared provided vision in the dark even as far back as World War II, by means of Sniperscopes and Snooperscopes. But these worked by near IR, and required an infrared searchlight. They were very effective as long as only one side had them. When both sides have IR equipment, it's likely to prove fatal to turn on an IR searchlight. However, if one can "see" by far infrared, then there's no need for the betraying searchlight, since enemy soldiers and other objects emit their own light.

The IR cameras used for the pictures accompanying this article are too slow for such military uses. They require a few minutes to produce a visible picture.

WHAT IS INFRARED?

INFRARED (IR), sometimes loosely called "heat rays," is the electromagnetic radiation that fills the part of the spectrum between visible light and radar. It covers a range from roughly 0.7 microns in wave length, where it merges into red light, to 300 microns, where microwave radar begins. (A micron is a millionth of a metre, or 0.00003937 inch.) It subdivides into three main regions, whose boundaries have not yet been precisely settled on, but which are roughly as follows:

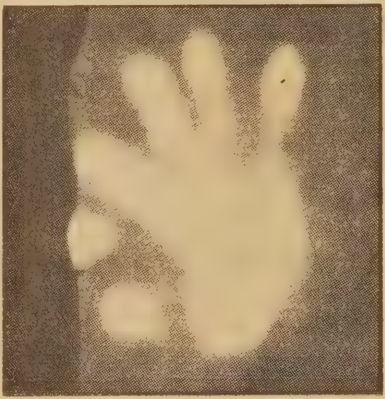
1. The near infrared (from 0.7 to 1.5 microns) is roughly the limit to which photographic film is useful. In this region a hot household electric iron will glow with its own "light" but objects at body or room temperature must be illuminated by an infrared light source like the searchlight of a Sniperscope.

2. The middle infrared (from 1.5 to six microns) has many important military uses. The jets of jet planes and rockets emit in this region, as do the friction-heated surfaces of transonic planes and missiles. Hence infrared-guided homing missiles like the Sidewinder "see" mainly middle infrared.

3 The far infrared (from six to 300 microns) includes regions where objects at room or body temperature radiate most strongly, so this region is used for "heat pictures." Unfortunately, however, detection of this long wave IR is comparatively difficult and most detectors have low sensitivity in this region.

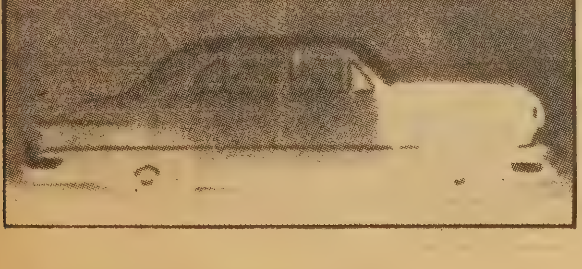
Much faster is the Evaporograph camera of Baird-Atomic, of Cambridge, which takes only a few seconds to produce a heat picture in coloured light reflected from a thin oil film.

But this is still too long. What's needed is a far-infrared TV process as fast as ordinary TV.



Heat picture of a human hand print. The hand was held against a wall for three seconds; 30 seconds later infrared radiation showed where the wall was still warm from its touch.

Is there work in progress to develop a TV camera tube sensitive in the far infrared? None that anyone would talk about. But it seems a safe guess that right now the U.S. and Russia are in a secret high-priority race to accomplish this. There's no theoretical reason why such a tube can't be made, and the side that gets there first will have a real advantage in ground warfare. One side could see at night almost as well as by day; the other would be fighting in the dark.



This infra-red photograph of a car shows that the car has been running. The bonnet is hot, as is the ground below the car, from the exhaust.

Military reconnaissance: If we can look up at a satellite, what about the satellite looking down at us? Specifically, have the Soviets been watching us through their Sputniks?

Hints dropped in talks by Russian scientists suggest that they have, though, of course, no one knows for sure. But here are a few facts about infrared surveillance to help us to decide:

IR reconnaissance by aeroplane during World War II was by photography, which is sensitive only in the near infrared. This pierced haze better than visible light, and penetrated some types of camouflage.

GOOD IDENTIFICATION

Present equipment using far infrared will be much more useful. For example, heat pictures can distinguish between a warehouse and a factory, even though both buildings may look the same under visible light, near IR, and radar. Even underground factories might be detected by hot gases released into the air, warm water entering a stream, heat escaping through the ground.

The Soviets could have put IR equipment in their satellites if they wanted to. Sputniks II and III have been plenty large enough for this. And infrared cameras similar to some now available would be fast enough for satellite use.

Articles published in technical journals suggest that the super-secret Lockheed U-2 observation plane, which relies on extreme altitude for protection, could be used for mapping and reconnaissance of Soviet territory.

The plausible conclusion is that it's entirely possible the Sputniks have been carrying IR observation equipment good enough to show the location of large cities. Almost certainly they can't now "see" fine details like individual buildings. But future Sputniks should be able to do this.

And the U.S. Project Pied Piper is intended to provide a huge observation satellite — sometimes referred to as "Big Brother" — for reconnaissance of the whole world.

A much pleasanter use for satellites is to make possible really good long-range weather forecastiing. Metreolo-

Another ROLA First!

This new Rola Model 2C loudspeaker has been designed for use in personal portables, particularly the sub-miniature transistorized types. Its physical dimensions are such that it will "marry" with standard printed circuit wafers and its efficiency such as to provide maximum performance from the tiny receivers for which it is designed.

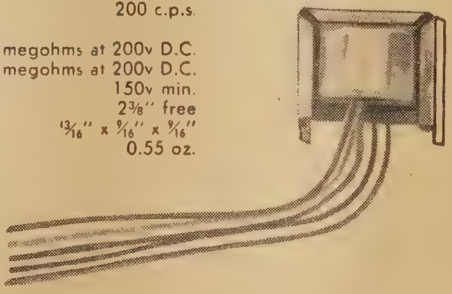
ROLA MINIATURE TRANSISTOR LOUDSPEAKER SPECIFICATIONS

Power handling capacity:	250 mWatts peak
Diaphragm:	
Fundamental resonance F1 cone	325 c.p.s. ± 25 c.p.s.
Frequency response:	300 c.p.s. — 4.5 K.C.
Voice coil impedance:	15 ohms at 1,000 c.p.s.
Air Gap Flux Density	7,000 Gausses
Gap flux:	11,100 Lines

Principal dimensions:	
Overall diameter	2¾"
Diameter of baffle opening	2½"
Diameter of voice coil	9/16"
Depth from pad ring to rear	1 1/32"
Finish:	
Cadmium plated housing and magnet assembly	
Weight:	2¼ oz. without transformer.

ROLA MINIATURE TRANSISTOR TRANSFORMER SPECIFICATIONS

Power handling capacity:	250 mW
Core saturation at 1000 c.p.s.:	Bmax > 5,000 Gausses
Centre tap unbalance:	
Output transformers	± 1.7% turns
Driver transformers	± 0
Insertion loss:	— 2 dB.
Low frequency cut-off:	200 c.p.s.
Insulation resistance:	
Between windings	> 100 megohms at 200v D.C.
Windings and core	> 500 megohms at 200v D.C.
Breakdown voltage:	150v min.
Lead length:	2⅜" free
Overall dimensions:	13/16" x 9/16" x 9/16"
Weight:	0.55 oz.



Colour code:

Output transformers —	Primary	start	Brown
		C.T	Red
		finish	Blue
	Secondary	start	Black
		finish	Green
Driver transformers —	Primary	start	Red
		finish	Blue
	Secondary	start	Yellow
		C.T.	Black
		finish	Green

ROLA COMPANY (AUST.) PTY. LTD.

gical data can be obtained with much smaller and simpler satellites than the "Big Brother" type. Right now, in fact, there's an IR "Weather Eye" system ready and waiting to go aloft in the next Vanguard.

This will observe and report on cloud cover over the earth. But later weather satellites will do a great deal more. Infrared is an excellent tool for chemical analysis, using different wavelengths to measure different compounds. The more sophisticated satellites will measure ozone, water vapour and carbon dioxide; study the heat balance of the earth; and give data on wind direction and velocity based on measurements of cloud motion.

A few satellites could continuously survey the whole earth.

FED TO COMPUTER

The data would be broadcast directly to a giant digital computer, along with other information from ground stations; and the computer would make the final forecasts. When this happy day arrives, we'll know that if we read, "Fair and continued warm today and tomorrow," and leave for a weekend at the beach, we won't run into two days of steady cold drizzle!

Doing something about the weather is even better than predicting it. And that brings us to the next topic: Outdoor radiant heating with middle infrared.

Radiant heating with electricity is pretty old, of course. The new gimmick is putting the heating wires inside silica tubes so that the radiant energy comes mostly from the tubes, not the wires. The silica emits mostly in the middle IR, whereas the hot wires in ordinary radiant heaters give off mainly near IR and visible light.

Too much of these wavelengths are reflected by white skin and light-coloured clothing, and thus wasted as far as warming a person is concerned. But in the middle and far IR, different shades of skin and most clothing and other ordinary materials (except polished metals) absorb the radiant energy well.

USED IN EUROPE

The silica heaters have already been in use in Europe for several years. They were installed in the grandstand at the 1956 winter Olympics in Italy. And travellers in France and Germany have been surprised to come upon sidewalk cafes with people dining outdoors in the middle of winter.

Among the first uses will be heating under the marquees of hotels and theatres, at toll booths, race-track grandstands and football stadiums. Downtown shopping districts may install the heaters to melt snow and provide March weather to lure customers on bitterly cold days.

Costs of radiant heating are reasonably low, because it warms people directly instead of first warming the air. And the silica heaters are fine for melting snow because snow absorbs longwave infrared well, though it reflects visible light and near IR.

Best of all are the prospects for home use. The heating is most effective and costs least, of course, when the area is shielded from the wind. So it may become common in the north to build low, ranch-style houses with the rooms placed around and facing in on an open court in the centre. We can imagine some future Christmas season with people dining in the courtyard under the stars, or singing carols there dressed in ordinary indoor clothing, beneath a cold December sky.

These are just a few of the possibilities we can see ahead. Infrared, though discovered back in 1800, has been the most neglected part of the entire radiation spectrum, from radio waves to gamma rays. Probably not even 1 per cent as much money has been spent on IR research as on radar research. Only during the past few years is the neglect beginning to end. So it's reasonable to expect that many new applications will be discovered, including some we can't even guess at now.

What about lie detection? What a lie detector really detects is a sign of emotional disturbance: A rise in blood pressure or a drop in the electrical resistance of the skin due to perspiration. An IR lie detector would detect a slight rise in the temperature of the cheek, a sort of invisible blush. Many people have thought of this possibility, though apparently no one has tested it yet. But there's every reason to expect it would work.

The great advantage of an IR lie detector is that the suspect wouldn't have to know he was being examined. The disadvantage would be the same as for all other lie detectors: It wouldn't work if the suspect didn't feel embarrassed at lying.

FOR POLITICIANS!

It might well be useless at political conventions when politicians make speeches promising to support the party platform. No experienced politician feels embarrassed about promising to support a platform! But reporters might find it handy to take concealed IR equipment to Press conferences. There they could cleverly mix in some embarrassing questions among the innocent ones and measure what happened to the "victim's" cheek temperature.

What about a lie detector that someone sitting in his living-room could point at a man's face on a TV screen? Unfortunately it doesn't look possible. Not even infrared can do that.

FIRST VOICES FROM OUTER SPACE

The voice of Sam Tindler (left) in charge of the U.S. Army's satellite-tracking station near Corona, California, was the first other than President Eisenhower's to be broadcast from the satellite Atlas. Tindler spoke to the Atlas two days after it went up, and then heard his message repeated. The tracking station, one of several the Army has in the U.S., used a bank of helical antennae like the one at the right to keep tab on the huge Atlas.

Fastest Trains Claimed By France

DUE to the growth of electrified lines and the utilisation of new diesel rail cars by the French National Railways, France claims to run the fastest trains in the world. A recent survey of normal operational speeds on the main lines of all countries shows France to top the list with 58 m.p.h., followed by the United States with 53.2 m.p.h., England with 53 m.p.h. and, in that order, by Denmark, Germany, Switzerland, the Netherlands, Belgium, Italy, Sweden, Canada, etc.

The "Mistral" Special (87 m.p.h.) holds the record over distances up to 372 miles and the "Sud Express" Special the record between 433 and 462 miles. On March 28 and 29, 1955, France also established the "absolute" world speed record on rails with 205.6 miles per hour. The electric locomotives used on these record breaking runs were designated by the numbers BB 9004 and CC 7107.

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FUTURE CAR ENGINES MAY BE OF ALUMINIUM

In order to cut weight and boost efficiency, engineers are looking to aluminium to replace iron in the manufacture of engines. Indications are that aluminium can now compete with iron in cost.

TODAY'S auto engines are the most efficient in history; but their miles-per-gallon efficiency is tempered by customer demand for good performance (acceleration), additional power accessories and steadily increasing car weights.

One important way to improve economy is to reduce the weight of the car, and a good place to start is with the engine. An aluminium engine can weigh up to 200 pounds less than its cast iron counterpart.

But this is only the beginning because the lighter engine requires less structure to support it, lighter tyres, lighter brakes and better weight distribution. It's like starting a snowball downhill.

An important development that makes aluminium engines look attractive for future passenger cars is application of high wear resistant alloys that eliminate the need for cylinder liners.

SATISFACTORY ALLOYS

Dr Thomson, a General Motors research engineer says that wear resistant aluminium alloys, including high silicon materials, have shown satisfactory wear characteristics both in dynamometer and field tests with experimental V-8 engines.

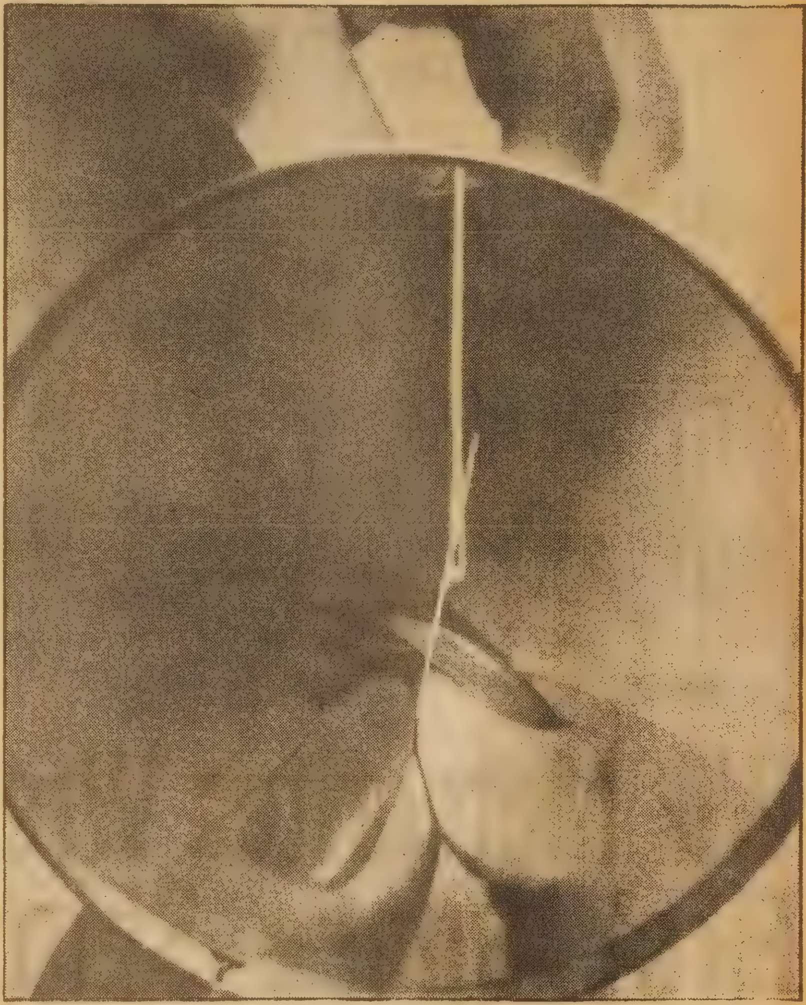
He had investigated various cylinder bore coatings, including chromium plate, iron plate, electroless nickel plate, oxide type coatings, sprayed steel, sprayed molybdenum, sprayed aluminium and its alloys.

These have shown varying degrees of promise from very good to unsatisfactory, but 100,000 miles of test driving indicate several possible solutions to wear and score problems under normal driving conditions.

"In the event none of these (coatings or alloys) finally meets all requirements, one can always rely on . . . a cast iron (cylinder) liner, although this is not the ideal solution and will not achieve the goal of maximum weight reduction at minimum cost. We do not believe . . . cast iron as a bore material will finally be necessary," he said.

"Of immense concern is the future thinking that car weights will be decreased. This will have two effects. The actual number of pounds of ferrous product will be reduced as car weight goes down but more importantly there will be an increased emphasis on reducing car weight without corresponding decrease in roominess and performance. So more and more, engineers will be trying to replace ferrous materials with light metals."

DRILL FINER THAN NEEDLE EYE



Microscopic precision is required to make this fine drill, only .025 inches in diameter, and seen here being passed through the eye of a needle. It is made by a Detroit tool-making firm, of superhard cemented carbide of a type used for fine work particulary as found in aircraft and missile instruments.

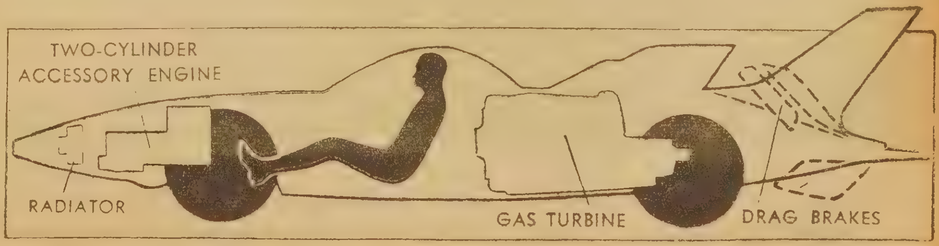
DREAM CAR IS COMPLETELY AUTOMATIC

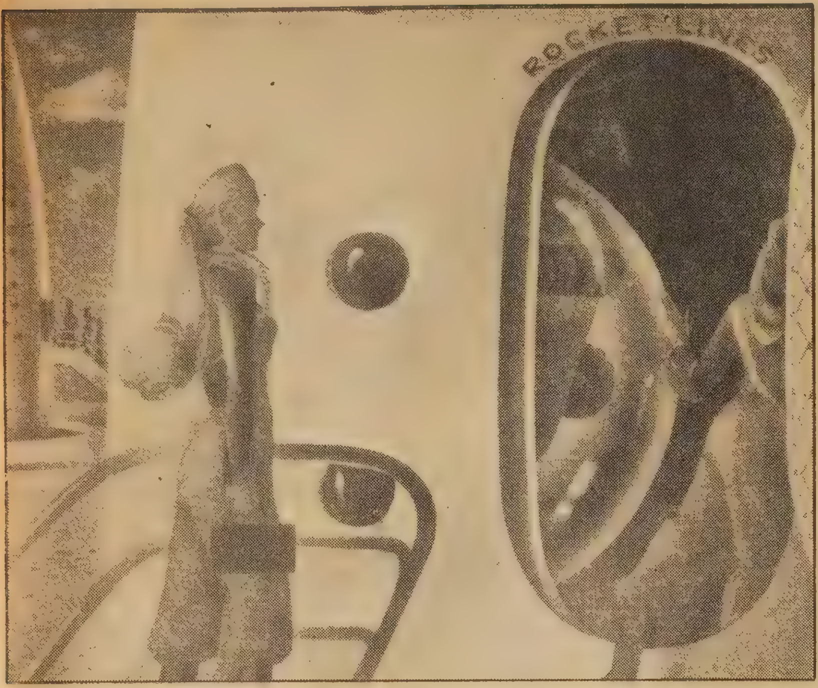
The General Motors Firebird III is an experimental multi-million dollar dream car which no one can buy or afford to buy. It is almost completely automatic.

AS you approach it, you blow a supersonic whistle and it opens to let you in. On guidance-equipped roads it will drive itself, which it does by means of a 225-h.p. gas-turbine engine in the rear, and a small, flat-twin auxiliary engine which operates the controls.

You drive it with a joy stick in the armrest between the two occupants. You pull it back to go, and push it forward to stop. A tilt right or left makes the turns, and the car backs when the handle is twisted. Two inches of movement equals two and a half turns of the conventional wheel.

The steering ratio varies with speed for high manoeuvrability and safety at high speeds. Built-in transistorised computers co-ordinate the controls.





Your holiday trip to Mars could be spoiled if your ship happened to collide with a few hundred tons of solid rock floating around in space!

Will Meteorites Wreck First Space Ships?

The immeasurable tract of outer space is not the empty void which many seem to imagine. The great cataclysm which originally gave birth to all the vast universes in outer space left a legacy of strange flying things which have seemingly travelled for millions of years between the orbits of various planets.

by Calvin Walters

A LOT of these "things" are nothing more or less than debris which seems to have been left from great stellar explosions, flying stones and dust, together with clouds of gas. These have no apparent order and merely float around in no specific orbits.

On the other hand there are larger objects which travel in well defined orbits.

Among these latter are the comets and asteroids. Taken together, all the objects which inhabit outer space are many and varied. They constitute one of the hazards of interplanetary space travel.

While clouds of dust and gas have no special significance from the viewpoint of spectacle it is the meteor and comet which often favour us with spectacular displays in the heavens.

Before talking about meteors it is well to get our definitions straight. A meteorite is a mass of solid matter travelling about in space. It is too small to be classed as an asteroid (see later) and too large to be classed as dust. A meteor is the visual phenomenon caused by the meteorite when it passes into the atmosphere.

We never see a meteorite in flight. We see only the meteor or light phenomena when the meteorite gets into our atmosphere.

It is only when a meteorite falls to earth that we actually see one, if it can be found.

To give some idea of the number of meteorites which are flying about in space, it has been established from a great many counts that about one million per hour are observable every night. The same number are of course falling during the day when they cannot be observed.

In addition to all these, there are what are known as telescopic meteors which can be seen only through a telescope.

It has been estimated that they are about one thousand times more prevalent than those visible to the naked eye. In all there are about one and one half billions of meteors per night. A goodly number indeed.

Then there are times when the earth becomes involved in meteoric showers, when the number is countless. One observer of a meteoric shower in 1833 estimated the number visible at one moment at 240,000.

VARY IN SIZE

Meteorites vary in size from very small bodies which are entirely consumed by the heat generated when they encounter our atmosphere to others of ten to twenty pounds in weight which still never reach the earth. There are still others, many tons in weight, which are not entirely disintegrated and which become buried in the ground.

The amount of dust from disintegrating meteorites is very considerable and estimates reveal that about 40,000 tons of this is deposited daily on the earth.

The composition of meteorites varies greatly. About 90 per cent of those which reach the earth are composed of grain-like bodies ranging in size from microscopic grains to those the size of a marble but most of the granules are less than two millimetres in diameter.

This type of meteorite is called a chondrite. They consist mostly of olivine, bronzite or glass. About 20 per cent of the chondrite may be a nickel-iron compound, with sulphides also present.

While the structure of the chondrite is different to terrestrial stony structures, thereby rendering it a distinctive object, there are others which are similar to stony terrestrial structures.

Among these are the achondrites which are crystalline structures of enstatite mixed with nickel-iron and some sulphides.

Most meteorites are crystalline in texture and contain nickel-iron in varying quantities, which suggests that these elements are very widely distributed throughout space.

The length of the course which a meteor takes varies according to the observer and the angle at which the meteorite enters the atmosphere.

Those meteors which appear as stationary flashes are those which enter the atmosphere in the direction of the observer so that the trail is not visible. When the meteorite enters at other angles the length of the trail may be anything from seven to 68 miles. The average length is about 29 miles.

Studies by various observers suggest that meteors come into view at from about 60 to 90 miles above the earth.

They disappear at from 30 to 50 miles above the earth. Variations in the sizes of meteorites account for the differences in these observations.

The speed of meteors also varies according to the direction from which they enter the atmosphere. For instance the earth travels around the sun at a speed of 18½ miles per second. Thus a meteorite entering the atmosphere from the rear will have its impact velocity reduced by the speed of the earth. A meteorite colliding head on will have its impact velocity greatly increased. It is the difference between colliding with a moving car from the rear or head on.

IMPACT VELOCITY

The impact velocities have been estimated at from 7 to 45 miles per second

Thus a meteorite entering the atmosphere from the rear will have a greater chance of survival and eventually to fall to earth than one entering the atmosphere head on.

The fact that millions of meteorites encounter the earth's atmosphere only from 60 to 90 miles up gives some idea of the hazards of collision by space ships.

The largest known meteorite on record is that near Grootfontein in South West Africa. This is a lump of iron measuring 9ft square by 3ft 6in thick, estimated as weighing 60 metric tons.

Allowing for the amount of material disintegrated into dust on impact with the atmosphere, estimates show that a meteor which weighed one ton at the earth weighed 500 tons at a point 12 miles above the earth.

Such a lump of dirt travelling at such speed would indeed render great havoc to any space ship. Fortunately there are not many this size in a confined space. It is like the fisherman who said that there are plenty of fish but a lot of water in between them. So there are many large meteorites but a lot of empty space in between them.

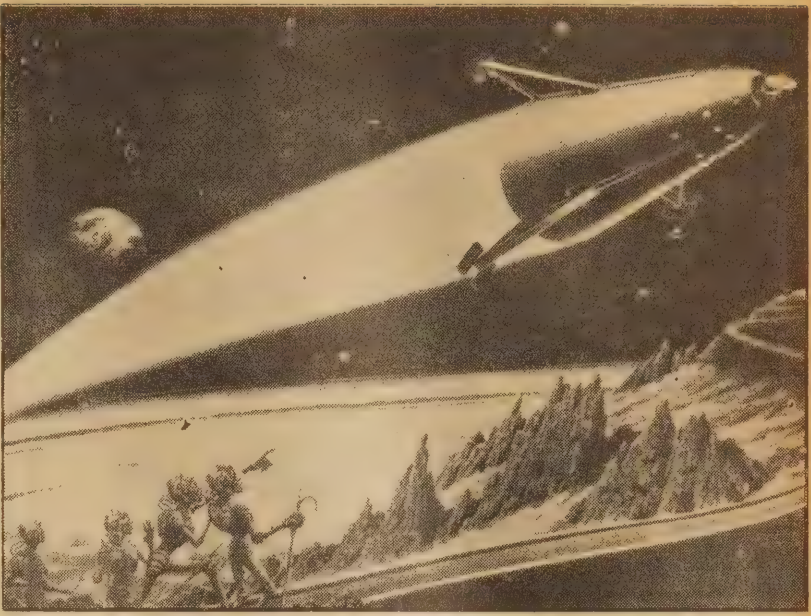
ASTEROIDS

Perhaps the largest lumps of material floating around in space, with the exception of the fixed stars and planets, are the asteroids or minor planets.

A space traveller can always avoid something which is fixed or moving on a known course but it is a different matter to avoid an object moving on an erratic course.

Between the orbits of Mars and Jupiter, in a circular belt 340 millions of miles wide, there are about 50,000 lumps of earth, called the asteroids or minor planets. These are moving in orbits some of which are known and some unknown. The orbits of about 1,600 asteroids are known and they can thus be found at any time through astronomical telescopes. The rest of them cannot always be found but they are there just the same.

The diameters of the largest four asteroids have been measured and are as follows:—Ceres 480 miles, Pallas 304 miles, Vesta 240 miles and Juno 120 miles. Names of some of the others are Amor, Apollo, Adonis, Hermes.



"ekirtS eM ykcuL" says some Martian version of Mo. "They made it. Comets and all!"

Most of the asteroids are merely large rocks but, as seen from the above diameters, some are quite prodigious. Hermes, for instance, although it is believed to be only about a mile in diameter, weighs about three thousand million tons.

As mentioned, the orbits of these minor planets are mostly confined between the orbits of Mars, and Jupiter. it is that word "mostly" which requires qualification.

Sometimes one of these baby planets moves beyond its usual outer limits or within its innermost limit and comes very close to the earth by astronomical standards. So close indeed that there in a near collision.

In 1937, Hermes, which has been shown to weigh three thousand million tons, came to within 485 thousand miles from the earth. This is only twice the distance from earth to moon and is far too close for something which wanders about in this fashion.

Prior to that, in 1936, Adonis came within 6,500,000 miles of the earth and in 1932 Amor was 10 million miles away. Thus the earth is beset on all sides by wandering minor planets. The effect on the earth of being struck by a body of 3,000 millions of tons weight would be unimaginable, although such a possibility is rather remote.

A HAPPY "MISS"

The speed of Hermes when it was close to the earth in 1937 was several miles per second and it was just as well that it went in the other direction at the right time.

There is a large crater in Arizona which has been attributed to the impact of a large meteor, but some scientists believe that it could have been caused by a collision with a small asteroid.

Such phenomena as the earth's collision with another star or some such object have always been subjects of discussion among those who believe that

A huge meteorite near Winslow, Arizona. Note its size compared with aircraft.

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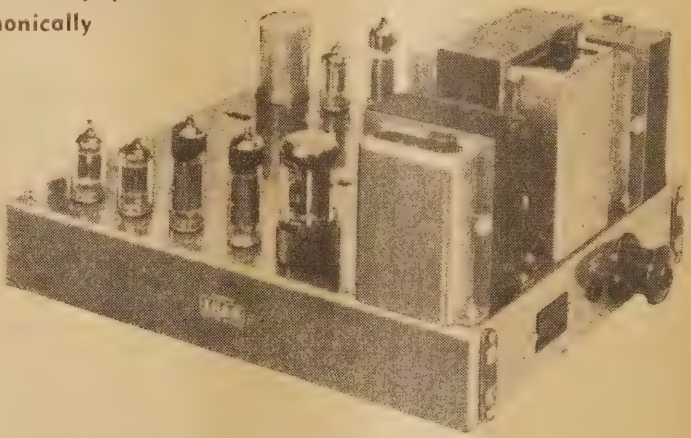

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at some time in the future the earth is to be destroyed for some reason.

In order to find out the possibility of such an event some astronomers have gone into intricate calculations.

The great astronomer Bok took the sun as his object for total destruction and has come up with the following interesting calculation.

The sun and our planetary system are in the Milky Way. In the Milky Way Bok estimates that there are two hundred thousand million stars. He says that any star equal in size to our sun will collide with a star of the same nature once in two hundred thousand million million years (200,000,000,000,000,000 and I hope the right number of noughts are there.) Thus any two stars could collide once in one million years. Further if the age of the Milky Way is two thousand million years there have been only 2,000 collisions during that time

WHAT ARE NOVAE?

Now and again astronomers observe what are called Novae in outermost space. They are great flare-ups and are regarded in two ways. Some believe they are stellar explosions. Others believe they are collisions between two stars.

Perhaps no celestial phenomenon has struck so much terror into the hearts of people over the centuries as has the comet

While the phenomenon associated with meteors is transient and lasts for only a few seconds, that of the comet is sustained and extends over a period of days. Comets also have the habit of making unexpected appearances as far as the public is concerned, although the well-known comets' appearances are known to astronomers days or years in advance.

In olden days comets were regarded as messengers from above and, as is usual with the superstitious, the messengers were regarded as those bringing bad news rather than good.

One notable instance of the influence of a comet on a throne was that of Louis I of France in the year 837

When a comet appeared in that year Louis was so scared that he devoted his time to building monasteries all over France and turned down his food, becoming a victim to fasting.

During early periods many people committed suicide at the appearance of a comet, believing it to be a warning of the end of the world.

ORDERLY PATH

Comets travel in orderly fashion around the sun in well-defined orbits but despite the prevalence of their appearances little is known about them particularly regarding their constitution

When a comet is discovered far away from the sun it has the appearance of a filmy globe with a brighter centre. The globe is called a coma and the brighter centre a nucleus.

As the comet approaches the sun it takes on a new appearance. The coma contracts, the nucleus becomes brighter and a tail appears on the side away from the sun. The closer the comet is to the sun the longer becomes the tail.

Comets, astronomers believe, have always been members of our solar system and none are actually new. They might appear new because in their

HOW LONG IS A COMET'S TAIL ?

Photographed over Ohio in 1948, this comet was first observed by a Japanese astronomer, Houda. Length of the comet's tail was quoted as "many millions of miles."

orbits they travel vast distances and, once seen, may never appear again until several lifetimes have passed.

The well-known Halley's Comet, one of the most spectacular objects to be seen in the sky, has a period of 75 years. It has appeared in 1910. It appeared in 1759, 1835 and will appear again in 1986.

LENGTHY PERIODS

Some comets have periods extending into thousands of years. For instance Messier's comet has a period of 3,200 years. Another one discovered by Messier in 1780 has a period of 75,600 years. The comet with the longest known period is that discovered by Delevan in 1914 with a period of 64,000 years.

The period of comets is calculated by accurately determining the distance of the comet from the observer and the sun and calculating whether the comet is taking the path of an ellipse, a parabola or a hyperbola and the length of the known path.

The fact that a comet travelling at speeds up to 400 miles per second takes 64,000 years to travel its orbit shows the vastness of space.

The coma of a comet consists of gas and dust. It has been put forward that, as the comet approaches the sun, the heat from the latter acts upon the nucleus of the comet, releasing a large amount of gas which forms the coma. The gases in the coma include sodium and iron, with a percentage of the poisonous gas cyanogen.

Sometimes the coma assumes gigantic proportions. The comet which appeared in 1811 had a coma at least a million miles in diameter. The nucleus of this comet was only about 430 miles.

Whilst nothing much is known of the nucleus of a comet it is believed to consist of a collection of objects both very large and very small a sort of celestial garbage collector as it were.

The tail is a most mysterious object. It appears to be influenced by the proximity of the sun. One theory fairly widely accepted is that the light from the sun drives the finest particles away from the nucleus.

Whilst, compared to its dimensions, a comet is very sparsely provided with solid matter, it is nevertheless a weighty object. So thinly divided is the material within a comet that other stars can often be seen through it and, when it passes across the face of the sun, it is not visible as it would be if it were solid.

It has been estimated that no comet is more than one-millionth as massive as the earth and some are much less.

HUGE TAIL

A comet's tail may be as much as one hundred thousand miles long. Even this part of a comet would have a large weight of dust.

It is thought that meteoric showers could be caused by the attraction of the large bulk of the earth drawing the finer particles of stones and matter from the nucleus of a comet when it passes in close proximity to the earth

Some people have fears that the end of the world is to be brought about by a collision of the earth with a comet. What are the chances of this and what would be the effect?

It is not all impossible that a comet would collide with the earth, as many

(Continued on Page 69)

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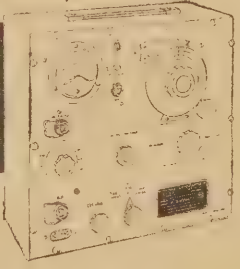

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Technical Review

ELECTRONICS NOW BRINGS LIGHT TO THE BLIND

The problem of restoring sight by artificial means has intrigued mankind since the dawn of time. But although literature abounds with examples of achieving this objective by miraculous processes, it took modern electronics actually to turn night into day for the sightless.

By John C. BUTTON, J.R., M.D.

THE dramatic event first occurred in a Los Angeles, California, hospital's operating room on the morning of October 29, 1957. Tiny holes were drilled in the skull of a volunteer patient. Wires finer than human hairs were placed in the holes.

Then came the real heroes — two home-made square-wave generators and a pair of cadmiumsulphide photocells. The result brought jubilation to a tiny knot of doctors and nurses gathered in the room. For a totally blind person **saw light** — through the magic of electronics — for the first time in medical history.

It sounds simple, but this simplicity is deceptive. Actually, the process of duplicating vision electronically is so staggeringly complex that few scientists, even after my initial experiments, thought it possible. Many are still sceptical. "Yes, you have obtained light," they protest, "but you will never get true vision."

OBVIOUS DIFFICULTY

Consider the most obvious difficulty. Each retina, in back of the eyeball, contains over one million individual light-sensitive nerve cells. Each cell is connected to its own nerve fibre.

Collectively, these nerve fibres traverse the brain from front to back in two bundles known as "optic nerves." In recesses deep within the brain the optic nerves pass through "relay stations" where they are joined by other nerves providing interpretive functions.

Here, indeed, are point-for-point mosaics of such intricacy that scientists have yet to explore them fully. These visual "cables" terminate in the very back of the brain, in an area half the size of a lemon, known as the visual cortex.

It is here that consciousness of vision actually occurs, and it is this area that was "tapped" by the author and his associate, Dr Tracy J. Putnam (a famed brain surgeon, now chief of neurosurgery, Cedars of Lebanon Hospital, Los Angeles, California).

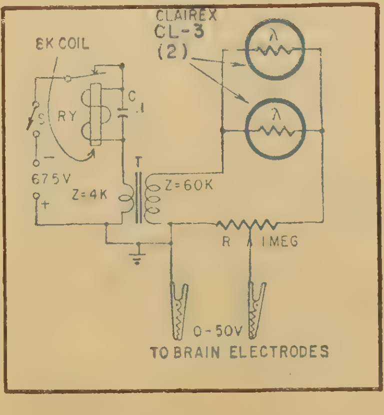
The logic behind selecting this spot is simple. First, the area is readily accessible from a surgical standpoint. More important, it is usually intact in blind persons. Nearly all blindness is caused by disease or accidents affecting either the eyes themselves or the sight pathways **forward** of the visual cortex.

By "plugging" directly into the visual cortex, all such parts are bypassed. Vision could then be possible — at least theoretically — even in a person **without eyes.**

The first step was to find a willing volunteer patient. Fortunately I had under my care a woman of 36, who had been totally blind for 18 years and who was willing to undergo the tests.

Two major problems now arose. First, would electrical stimulation of the visual cortex actually produce flashes of light in our patient? It was common knowledge that it would in persons with normal sight.

The phenomenon had been demonstrated on numerous occasions during brain-mapping studies at research centres in the United States and Canada. But no such tests had been performed on truly blind individuals, who conceivably might not react in so-called normal fashion.



Circuit of the vibrator supply.

Furthermore, most scientists felt that sight cells in the brain of a person who had been blind for any length of time had probably atrophied or dried up from extended lack of use. This happens with most bodily functions if they remain unused. Why, asked the scientists, should the sight cells be the only major exception to the rule?

A second basic problem faced us. If electrical stimulation of the brain produced flashes of light what then? How could such flashes be correlated with outside illumination to provide a practical measure of sight?

FREQUENCY, STRENGTH?

We answered the second question first. The flashes of light (if they occurred) would be induced by electricity of a certain frequency and strength.

To pick up evidence of outside light rays we needed only a way to convert light rays into electrical current of the previously determined specification. This, we believed, could be done using cadmiumsulphide photocells connected to the brain through a simple vibrator power supply.

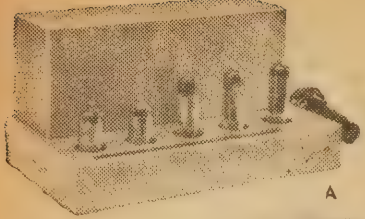
The answer to the first question would have to await the results of our first operation, which we scheduled for October 29, 1957.

The night before the operation a small patch of hair was removed from the back of the patient's head and the skin was prepared with antiseptics. In the operating room the following morning, novocaine was injected into the skin of the area, but otherwise no anaesthetic was used.

A sleeping patient could not tell us anything.

Four tiny holes were drilled through the back of the skull and four needles, each 4in long, were inserted through the holes directly into the substance of the brain. (This area of the brain does not have nerves of sensation, hence the patient experienced no pain.)

Four stainless steel insulated wires, each 6in long and .003in in diameter,



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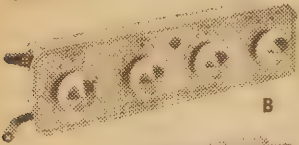

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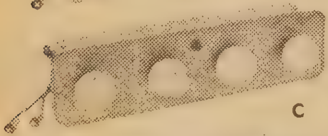

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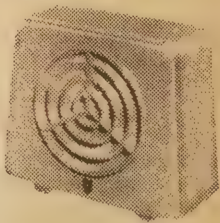

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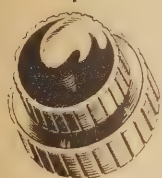

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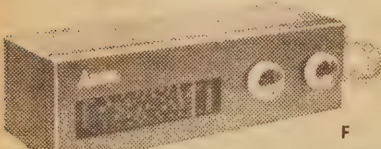

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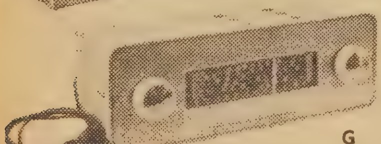

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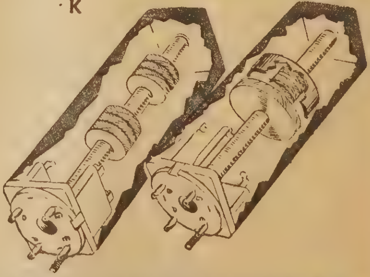

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were inserted through the needles. To insure contact with the sight cells 1 millimeter of insulation had been scraped from the tip of each wire. The needles were then carefully withdrawn, leaving the wires approximately 2in deep within the brain and held fast by tissue elasticity.

The first crucial moment had arrived. Would we get flashes of light, or would our courageous patient remain locked in her closet of darkness?

We signalled, and a nurse quietly trundled a surgical tray up to the patient lying on the operating table. On the tray were the two small, make-shift supply units we had fabricated only the day before out of second-hand parts at a nearby electronics store. Total cost, including a brace of cadmiumsulphide photocells attached to one unit — 9.45 dollars. The vibrator's simple circuit, with the photocells connected, is shown in the diagram.

THE "IMPOSSIBLE"

Here, perhaps, an explanation is needed. This was medical history in the making. We were about to embark upon a sea that had been charted by miracle-workers but never by scientists. We were about to attempt to demonstrate something that most of our colleagues had, by scientific logic, "proved" impossible. Yet we were using makeshift, home-made, second-hand equipment of so primitive a nature that grade-school students would have laughed at it. Why?

There were two good reasons. Firstly, we couldn't be sure what precise current specifications would be required, hence we didn't have any way of knowing what type of equipment (in simple, available form) would best serve our purpose. So we chose the most elementary — a primitive vibrator supply, which we hoped would put out a square wave of the proper strength and frequency.

There was another good reason. We lacked funds. Nobody had come along to underwrite our tests. We **had** to do things the cheapest way. Perhaps this sounds "undignified" for research scientists. Nonetheless, it is true.

The patient was lying quietly, expectantly, face down on a special headrest. The four tiny wires dangled from the back of her skull, their free ends barely discernible in the reflected glare of the operating-room light.

FIRST TRIAL

One of the vibrator supply units was plugged into an outlet. Its two alligator clips were clamped on to the free ends of two of the wires.

"Betty," I said, "tell us if you see anything."

A hush fell over the operating room. Nurses, doctors, attendants—all paused like statues. The current was applied.

"I see a flash! I see more! I'm seeing flashes of light!"

A silent cheer seemed to emanate from the white-garbed figures encircling the patient.

"It's . . . it's gone! The flashes are gone!" There was a throb of disappointment in Betty's throat.

My colleague and I looked at each other, smiling beneath our surgical masks.

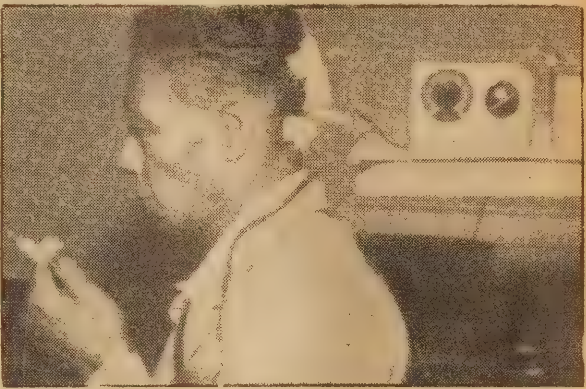
"That's as it should be, Betty," I said, trying to suppress some of the jubilation I felt. "We've turned off the current. Now — watch again."

Another pause. Then . . . "There it is! There they are! The flashes again!"

Again and again we manipulated our single little dial. Again and again our patient's responses indicated without question that she perceived flashes of light.

It was time now to forget the drama of the experience, at least for the moment, and record our findings. After multiple trials we determined that the current giving our patient the keenest flashes of light measured 25 volts and 620 uA at 75 pulses per second. The dc impedance between electrodes measured 40,000 ohms.

Surely this was far in excess of any voltages encountered in the physiological process of vision as provided by nature! To be sure it was, but nature does not have to contend with such hindrances as electrode resistance, which in our opinion was principally responsible for our relatively high voltage.



With vibrator hooked up, patient can detect light. This represents an important advance but a vastly more complicated system would be necessary to allow them to visualise light patterns.

Normally, vision is produced when light falls on the retinal cells in the back of the eyeball. These light rays first initiate a chemical response, which is instantly converted into an electrical current of almost infinitesimal proportions and then transmitted to the very centre we had tapped—the visual cortex in the back of the brain. But what nature does, and what man must do to duplicate her wonderful processes, are sometimes vastly divergent.

Betty, holding the photocell, locates the candles on her birthday cake. Dr Button is at the right.

Did the patient feel any discomfort during the electrical trials? Beyond a certain voltage point, she became aware of sensations of mild electric current in her head, which she described as a sort of vibration. But when the current was kept at the previously determined optimum level, 620 uA, she felt no discomfort.

Now, we were ready for the second phase of our experiment. We had produced the flashes of light, proving, among other things, that after 18 years of total blindness our patient's brain cells, for reasons we have yet to determine, had **not** followed nature's usual rule and dried up.

But the flashes of light, dramatic as they were to one accustomed to total, permanent darkness, actually were of no practical value. We still had to prove that outside sources of light could be picked up and fed to our patient's brain.

I breathed a prayer and picked up a double cadmium-sulphide photocell which we had previously attached in series with one vibrator supply. Theoretically, when the dial was set to approximate the current specifications we had already determined the patient should receive light impressions if she pointed the cell at a light.

"Betty, hold this little gadget. It's like a tiny flashlight. Tell us if you see anything."

The massive operating-room lights were turned off and a gooseneck lamp containing a 40-watt bulb was brought up to the patient. Its switch was noiseless — Betty couldn't fool us or herself.

"There! There's a light! It's not a flash. It stays on!"

OFF AND ON AGAIN

Betty's hand, holding the photoelectric cells, had been guided to within a few inches of a burning 40-watt bulb.

"Now it's off. I don't see anything."

My colleague silently gave the well-known Churchillian victory sign. The light, sure enough, was off.

"Now, Betty, tell us when it comes on again. Tell us whether it's weak or strong."

There was a pause. Then . . . "There it is! But it's faint. Very faint."

I was, in fact, holding the light several feet from the photoelectric cells. Gradually I brought it closer.

"Now it's getting stronger! Now it's much stronger! Oh . . . it's dazzling!"

The final test, in the operating room that day, provided what was almost a forgone conclusion. Betty would have to find the light unaided.

(Continued on Page 127)

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How many times have you seen an oscilloscope trace go wild when you moved the scope's probe from one point to another in a circuit? Almost always is probably the answer unless you own a relatively expensive oscilloscope—or have added a Schmitt trigger circuit as described in the following article.

By Daniel Meyer*

LOSS of sync can be traced to the sweep and sync circuits used in most inexpensive scopes. The sweep circuit in most of these is a simple cathode-coupled multivibrator, or perhaps a gas triode.

The multivibrator is very similar to the one used as a horizontal oscillator in TV sets. The main difference is that the frequency of the scope's multivibrator can be varied over a wide range by changing the R-C time constant between the two tubes.

Sync. signals, consisting of a portion of the signal being viewed, are applied to the grid of the first tube section. These signals are tapped off the scope's vertical amplifier and fed to a sync. amplitude control which controls the amount of sync. signal reaching the sweep multivibrator.

This is all well and good, but a multivibrator is critical when it comes to both the voltage and waveshape of the sync. signal. Sync. signals reaching it must have the following characteristics to give reliable triggering (see Fig. 1):

Rise time	0.1 microsecond
Decay time	1.0 microsecond
Shape	Peaked
Amplitude	Constant

If the pulse has a slow rise time, like a simple sine wave, the multivibrator needs considerably more sync. voltage to lock in at the same frequency as the signal being viewed than it would if rise time were fast.

LOSS OF SYNC.

The variation in signal level and waveform being applied to the sweep circuit is what causes the scope to lose sync. when the probe is moved from one point to another in a circuit.

For example, if the scope is adjusted to check hum at 60 cycles and the probe is moved to a vertical oscillator circuit, the scope will probably lose sync. because of the difference in waveforms, even if voltage levels are approximately the same.

We can supply the sweep multivibrator with an almost ideal synchronising pulse with a simple one-tube circuit known as a Schmitt trigger. A typical pulse produced by this type circuit is shown in Fig. 2.

Fig. 3 is a basic Schmitt trigger circuit and helps explain the action of the circuit. A Schmitt trigger consists of two amplifiers having direct plate-to-grid and cathode-to-cathode coupling.

The circuit has two stable states — V1 conducting, V2 cut off; V2 conducting, V1 cut off. The changeover from one state to the other is very rapid, producing fast rise and decay times from each side of the circuit. Either one can be used for triggering.

The DC voltage applied to V1's grid determines which state the circuit is in.

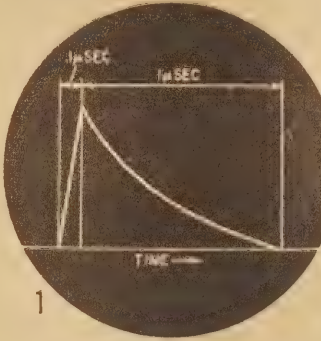


Fig. 1—Characteristics of a good sync signal.

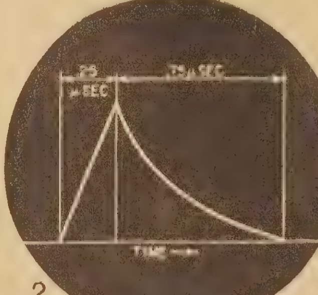


Fig. 2—The pulse developed by a Schmitt trigger circuit.

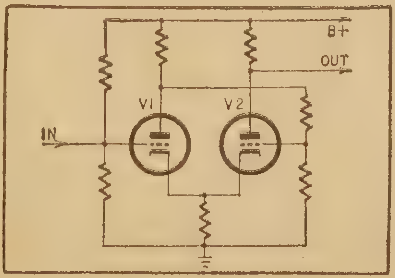


Fig. 3—Basic Schmitt trigger uses two triodes with direct plate-to-grid and cathode-to-cathode coupling.

If the grid voltage is above a certain value, V1 conducts and V2 does not. If V1's grid voltage is below this value, V2 conducts and V1 does not. Each time V1 crosses this threshold, the circuit changes state.

In practice, the voltage is higher when moving the grid in a positive direction and lower when moving it in a negative direction. The two voltage levels are called the upper and lower hysteresis limits of the circuit.

To trigger the circuit, V1's grid voltage must cross the particular hysteresis limit which will change the state of the circuit. If V1 is already conducting, driving the grid voltage more positive through its upper hysteresis limit has no effect but driving the grid voltage more negative through its lower hysteresis limit cuts off V1 and starts V2.

V1 is normally off in this circuit, and the symmetry control is adjusted to turn it on at the proper time after the circuit is triggered by a positive-going signal. The symmetry control is adjusted to place V1 halfway between its upper and lower hysteresis limits.

BEST SETTING

This is the most sensitive possible setting for the trigger circuit.

Now, let's go to Fig. 4, which shows the circuit to be added to your scope. When a signal of sufficient amplitude reaches V1-a's grid, the circuit switches states and produces a fast-rising pulse at V1-b's plate.

This pulse is differentiated by C3 and R9. The waveform now closely resembles the pulse shown in Fig. 1. When the grid voltage falls, the circuit again switches states and the diode shunting the choke in V1-b's plate circuit conducts, clipping the negative-going pulse.

This signal is fed to the input grid of the multivibrator. The sync. amplitude control R9 is also connected to this grid. It controls the size of the pulse by changing the time constant of the differentiating circuit of which it is a part. If this is not done, the impulse will be strong enough to hold one cycle of the waveform being viewed over most of the fine-frequency range.

R9 and R10 are original scope components, but if these parts in your scope do not have the values shown in the schematic (Fig. 4) they must be replaced with the specified values.

CLOSE TO SWEEP

The pulser should be mounted as close to the sweep multivibrator as possible. The output pulse will be steeper if it is not loaded by any unnecessary wiring capacitance. The lead to the sync. amplitude control should be as short and direct as possible for the same reason.

B-plus for the pulser can be obtained from a 120-volt line if your scope happens to have one. If not, a dropping resistor and bypass filter capacitor must be used to reduce the voltage applied to the tube.

The pulser draws 13mA so the required resistor can be found with the following formula.

$$R = \frac{X - 110}{.013}$$

where X equals the available voltage.

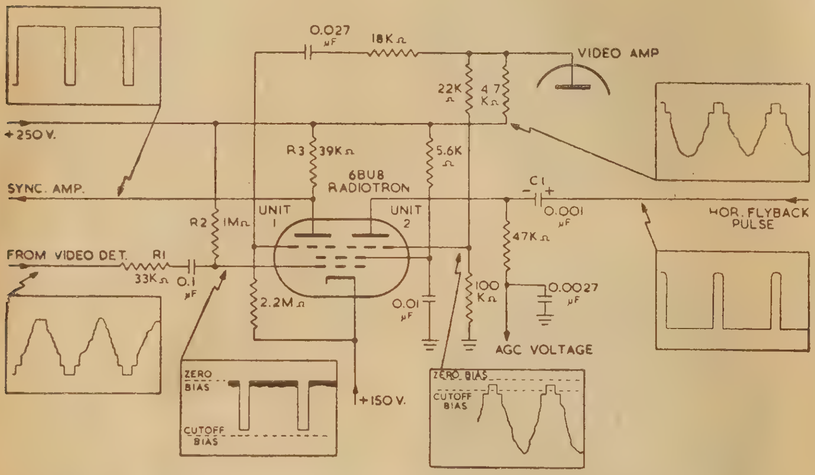
---

*"*Radio Electronics*"

RADIOTRON

TELEVISION VALVE SERIES

The Radiotron 6BU8 is a sharp cutoff twin pentode intended for use in sync.-clipping and agc amplifier circuits of TV receivers. In this application one pentode unit operates as a combined sync. separator and clipper, whilst the other pentode unit provides an amplified agc voltage. The design consists of two identical pentodes with common cathode, grid No. 1 and grid No. 2. Other design features include a sharp plate current cutoff characteristic of the third grids, an ultra-sharp plate current characteristic of grid No. 1, and a large ratio of gm between grids Nos. 1 and 3.


0.027 µF
18K Ω
VIDEO AMP
22K Ω
4.7 KΩ
+250 V.
R3 39K Ω
5.6K Ω
6BU8 RADIOTRON
SYNC. AMP.
C1 0.001 µF
HOR. FLYBACK PULSE
R2 1M Ω
UNIT 1
UNIT 2
47K Ω
FROM VIDEO DET.
R1 33K Ω
0.1 µF
100 KΩ
0.0027 µF
2.2M Ω
0.01 µF
AGC VOLTAGE
ZERO BIAS
CUTOFF BIAS
+150 V.
ZERO BIAS
CUTOFF BIAS

SIMPLIFIED CIRCUIT OF NOISE-GATED SYNC. CLIPPER AND AGC AMPLIFIER.

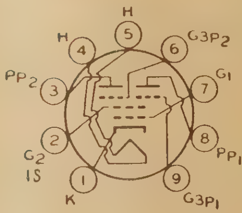
With a nominal (negative-going) composite video signal at the detector, values of R1, R2 are so chosen that during sync pulses the sync. tip level is slightly less negative than the plate current cutoff bias. Noise pulses of an amplitude extending beyond the sync. tip level will now cut off plate current, so that during the noise pulse there is no output from either the sync. clipper or the agc amplifier.

In unit No. 1, G_3 and anode function as a conventional sync. clipper, with the positive-going composite video signal applied to G_3. Negative-going sync. information appears across R3 after clipping and amplification.

In unit No. 2, G_3 and anode function as a keyed agc amplifier, in which plate current flows only during sync. pulses. Plate current amplitude depends on the sync. tip level at G_3, which depends on the video amplifier output level. This in turn depends on the video detector output level. When plate current flows in unit No. 2, C1 will be charged to a potential the amplitude of which is determined by the plate current amplitude. The negative voltage at unit No. 2 anode is therefore determined by the video detector output amplitude. This voltage may be used after filtering to provide agc on the if and rf amplifiers.

6BU8

SOCKET CONNECTIONS
Bottom View


H
H
G3P2
PP2
G1
PP1
G2 IS
K
G3P1
1
2
3
4
5
6
7
8
9

PIN 1 - CATHODE
PIN 2 - GRID NO.2 INTERNAL SHIELD
PIN 3 - PLATE OF PENTODE UNIT NO.2
PIN 4 - HEATER
PIN 5 - HEATER
PIN 6 - GRID NO.3 OF PENTODE UNIT NO.2
PIN 7 - GRID NO.1
PIN 8 - PLATE OF PENTODE UNIT NO.1
PIN 9 - GRID NO.3 OF PENTODE UNIT NO.1

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VC.11.

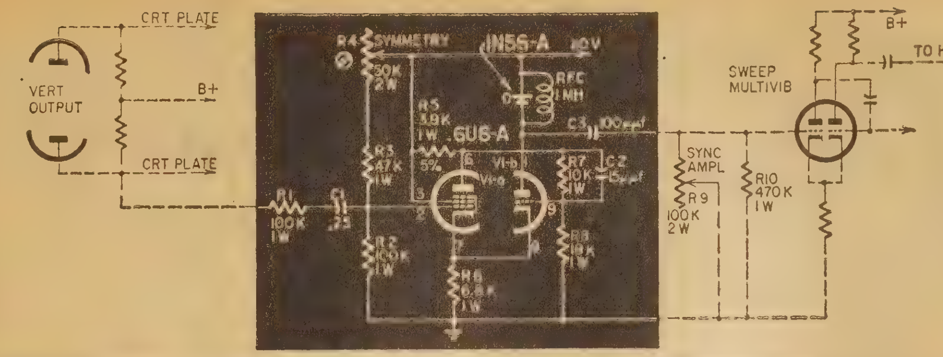


Fig. 4—This is the circuit you add to your scope to pulse-sync the instrument.

LIST OF PARTS

R1, 2—100,000 ohms
R3—47,000 ohms
R4—pot, 50,000 ohms, 2 watts
R5—3,900 ohms, 5%
R6—6,800 ohms
R7—10,000 ohms
R8—18,000 ohms
*R9—pot, 100,000 ohms, 2 watts
*R10—470,000 ohms
All resistors 1-watt 10% unless noted
C1—0.25 uf, 400 volts
C2—15 uuf, disc ceramic
C3—100 uuf, disc ceramic
D—1N56-A
RFC—1 mh
V1—6U8-A
Vector socket, 9-pin
Miscellaneous hardware
*These parts are in your scope. However, their values may differ. If so, replace them with the values shown.

Note that the circuit, with the values shown, will not work at voltages much over 130. However it will work with reduced pulse output — down to 70 or 80 volts. So use a larger rather that a smaller resistor if the value calculated is not a standard size.

To adjust the symmetry control, connect the B-plus voltage but leave the input and output temporarily free. Then connect the input to an audio oscillator set at about 15,000 cycles. Connect the pulser's output to the scope's vertical input. Turn the symmetry control until an output is observed on the scope. Adjust for equal spacing between the positive pulses and the clipped negative pulses. (See Fig. 5.)

Make this adjustment with the least possible signal that will cause the circuit to switch. If an audio oscillator is not available, this adjustment can be made with a 100-ohm potentiometer across the heater line with its tap connected to the pulser's input. Adjust as before for triggering with the least possible signal.

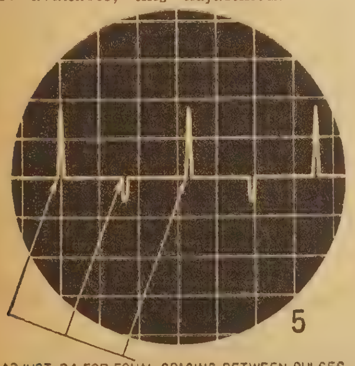


Fig. 5—When you get this pattern on your scope screen, the symmetry control is adjusted properly.

Now lock the setting with a drop of paint or glue on the shaft of the symmetry control potentiometer. No further adjustment is needed unless the trigger tube is changed.

It takes about 5 volts to make this circuit switch states. This is equivalent to a trace about ¼in high, and the scope will not synchronise on a signal smaller than this. If desired, bypass the pulser with a S.P.S.T. switch so you can observe signals too small to trigger the pulse circuit.

A sync. amplifier can be used ahead of the trigger generator if pulsed sync. is desired at extremely low levels. Such small signals are generally of no value in service work, so this feature was not incorporated in my unit.

Operating the scope with the pulser installed is almost the same as using standard sync. Turn the sync. amplitude control all the way down. With a signal applied to the scope's vertical input, adjust the fine-frequency control until the signal is reasonably close to the point where it should lock in. Now slowly advance the sync. amplitude control until the picture jumps into sync.

Advancing the control beyond this point will cause the number of cycles of the signal on the screen to decrease until only one is left as the control approaches full output.

Using the scope should be much easier with pulse sync. installed. The stable trace produced should make service work less troublesome and much more pleasant.

AGE OF THE JET

(Continued from page 7)

may be either a kerosene type or (less commonly) a fuel which is about half way between kerosene and gasoline in volatility.

Of particular importance is the cleanliness of the fuel. Extra precautions in handling the fuel, from the refinery into the aircraft, are called for, since even minute quantities of dirt which would pass harmlessly through a piston engine's carburettor can cause trouble in a gas turbine's fuel-injection nozzles and in the delicate meters which control fuel flow.

Stability under heat is another vital factor. A fuel that forms gum or carbon cannot be used since any deposit on the nozzles would change the combustion pattern within the engine.

Extensive and detailed preparations for the jet age have already been made, though (disregarding turboprops) only a score or so of jets are yet in commercial service in the world. But the jet age is arriving with such a rush that well over 100 are due for delivery to the world's airlines this year, and nearly 300 in 1960.

The cost of re-equipment of the world's major airlines with jets will run into colossal figures. By 1962, the various United States airlines alone will have spent the equivalent of well over £A1,000,000,000 on 400 jetliners and improved ground facilities.

Aviation specialists predict that within 15 years or so, piston-engined aircraft may constitute no more than one-seventh of the world's commercial air fleet. The forecast is that jet will then be used for almost everything except freight and feeder services.

Expansion that will take place in jets, however, will means that the 1975 air fleet will be vastly greater than today's and will be handling a far larger share of the transportation load.

Meanwhile, airline operators are anxiously watching the travelling public's reaction to the jetliner as a means of travel. Not only is there the problem of filling the extra seats made available by the greater speed and capacity of the new planes—within three years this will double the seats available in the United States, for instance—but there is a public wariness of the new jets which must be overcome.

In spite of this hesitancy, operators feel that the public's reservations will prove to be transitory, and they are confident that before long jet travel will be as commonplace as more conventional air travel is today.

And what of the future? Is the limit yet in sight?

Already the designers are feeling their way towards new advances. The next step will be huge supersonic jetliners capable of carrying 300 passengers or so at speeds of 1,500 to 2,000 m.p.h. and at altitudes of 60,000 feet and higher.

The great U.S. firms of Lockheed and Boeing already are at work on plans for such aircraft, but experts do not minimise the practical difficulties, particularly on the economic side, that have to be overcome. All things considered, it would seem over-optimistic to expect such aircraft to appear, even experimentally, in less than ten years.

★ CRYSTAL MICROPHONES ★ MICROPHONE INSERTS

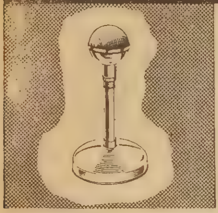


TABLE on STAND MICROPHONE MIC22

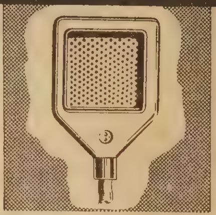
This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low-frequency wind noise will not affect the performance. An adaptor (floor mounting) is available at low extra cost.

PRICE £9/18/6.

CRYSTAL MICROPHONE MIC40

The MIC40 has been pleasantly styled in a variety of two-tone colours to give a handsome quality Microphone of modest dimensions and unassuming price. Ideal for tape recorders with a minimum of stowage space available, and a wide range of domestic applications.

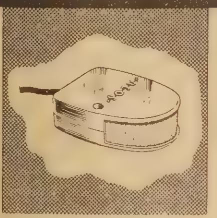
PRICE £3/19/6.



LAPEL MICROPHONE MIC28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded-rubbe case which gives protection against shock it is provided with a pin at the rear of the case for pinning to the lapel

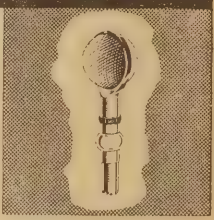
PRICE £5/19/6



GENERAL PURPOSE, MIC35

The MIC35 is housed in an attractive die-cast case, it features a high sensitivity and substantially flat characteristics Provided with a built-in shunt resistance of 2 megohms, it will, when connected to the grid of the input valve, give a substantially flat response from 50 to 5,000 c.p.s.

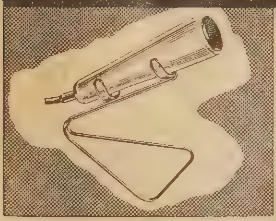
PRICE £2/15/-



HIGH-QUALITY MICROPHONE, MIC16

Incorporates the world-famous floating crystal sound cell construction. Its fine performance is not affected by vibration or shock, and the fidelity is not impaired by low-frequency noise.

PRICE £24/19/6.

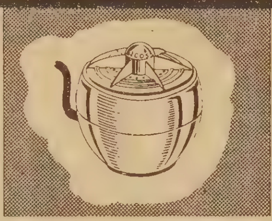


CRYSTAL STICK MICROPHONE, MIC39-1

The MIC39-1 has been beautifully styled as a hand, desk stand or floor stand unit, and precision engineered to the highest professional standards

A heavy die-cast liner in the microphone case eliminates the possibility of hum pick-up due to hand capacity effects The use of a special noise-free cable improves screening and gives a greatly increased signal-to-noise ratio

Designed especially for high quality recording, broadcasting and public address work. PRICE £8/19/6 complete with desk stand



HAND or DESK MICROPHONE, MIC33

Has been designed for the public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case. Unaffected by vibration, shock or low-frequency wind noise Omni-directional frequency response substantially flat from 30 to 7,000 c.p.s.

PRICE £6/16/6

CRYSTAL MICROPHONE INSERTS

These inserts are available in varying sizes, ranging from as small as 15/16 in. square to 1 13/16 in. round, with various thicknesses from 7/12 in. to 9/16 in. Suitable for every purpose, such as hearing aids, public address, tape recordings, amateur transmitters, etc., they have responses from 2,250 c.p.s to 3,500 c.p.s. at —5 db to —30 db. Insert can be supplied with or without 10 meg. resistor as required. MIC19/4 and MIC32, £2/15/6; all others £1/19/6

DESK or HAND MICROPHONE, MIC36

Ideal for home recording, public address, etc. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.ps. Recommended load resistance not less than 1 megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost. PRICE £6/18/6.

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NEWS AND VIEWS OF THE MONTH

Satellite mail box

BRIG.-GENERAL DAVID SARNOFF, Chairman of the Board of the Radio Corporation of America, recently announced that RCA is studying possible uses for special-purpose satellites, including an orbital post office, to speed mail delivery anywhere in the world.

In a year-end statement on the highlights of RCA's business and financial activities, General Sarnoff said that RCA scientists and engineers, who developed a large part of the communications relay system for the Atlas satellite, are now investigating satellite relay stations for international television as well as orbital weather stations.

"It is conceivable," he said, "that satellites could enable an international control organisation to observe major threats to world peace, and warn against an impending attack anywhere on the globe."

Among RCA's major achievements of 1958, General Sarnoff listed the following:

Development of a new micromodule concept in electronic circuitry that makes possible the reduction of many important military items to one-tenth—and in some cases to as much as one-thousandth—their present bulk. Experimental circuits, including entire assemblies of transistors, wiring and other elements compressed into micromodules no bigger than a cough drop, have been built for the Army Signal Corps.

Introduction of almost 100 new products, including the first fully transistorised, general-purpose electronic data processing system.

Inauguration of a Ballistic Missile Early Warning System of long-range radar bases in the Far North.

Development of an automatic check-out system that will reduce the "count-down" time for the Atlas ICBM. The novel system will help make the Atlas ready for firing almost immediately after an alert, instead of from 10 to 15 hours later.

Improvements in colour television production and programming that were reflected in a "significant increase in sales."

BBC tests stereo on radio

THE sound of a knife whistling through the air at close quarters was just one of the startlingly realistic sounds heard in the first radio drama in stereophonic sound ever to be broadcast in Britain when the B.B.C. recently presented a sequence of scenes from the play "Sherlock Holmes" as part of the series of stereophonic sound tests.

Other effects were of a hansom cab which appeared to drive right across the rooms where people were listening and the voices of Holmes and of Moriarty's men as they moved in the darkness of the gas chamber from which Holmes and Miss Faulkner escaped. "All this does not boil down simply to another device, or a plaything," explained B.B.C. producer Raymond Raikes.

"It means that radio can free itself completely from the restraints of the past and yet preserve and heighten that close-up intimacy—the ability to move right into an actor's mind — which it has always conveyed better than any other medium."

In a subsequent stereophonic transmission the B.B.C. presented music played by the B.B.C. Symphony Orchestra.

The stereophonic system so far used by the B.B.C. in a succession of experiments demands two transmission channels and two receivers in listeners' homes.

B.B.C. engineers are now studying new single-channel stereophonic systems, which aim at developing a new compatible system using a single transmitter for sound, whereby the listener with a single conventional receiver and the listener who had had a second sound-reproducing unit fitted to his receiver could both hear the same production at the same time—one in the normal way, the other stereophonically.

Air as lubricant

AN electric motor and air-circulator which has been started and stopped more than 600 times without ill effect uses bearings lubricated with air. They are not the normal air-bearings in which a supply of compressed air is used to hold apart the moving parts. The air is used in exactly the same way as oil in a normal hydrodynamic bearing. The motion of the shaft drags a layer of air under the loaded part of the bearing.

Air bearings of this kind are of interest in applications where an electric motor, for example, has to work in a sealed vessel under conditions where oil could not normally be used.

The de Havilland Engine Company Ltd. has used an air circulator with such air bearings in building the high temperature gas-cooled reactor test loop to go in the Pluto reactor at Harwell. The

A new portable television set which has just been presented at the International Radio and Television Exhibition in Paris. The set is 30 cms long and 17 cms. high and its screen measures 21 cms. It works on an ordinary car battery as well as on 110 or 120 volts current.

**DEALERS, SCHOOLS,
SERVICEMEN, GARAGES,
ELECTRICIANS,
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GOVERNMENT DEPTS.**

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★ BRIDGES By A.W.A., Avo, Omega, Taylor, University.

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★ FIELD STRENGTH METERS By Klemt, Seal.

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★ MULTIMETERS See our Advertisement on page

★ OSCILLATORS By Advance, Avo, A.W.A., Palec, Taylor, Klein & Hummel, Hartmann & Braun, Cossor, University.

★ PROBES By A.W.A., Avo, Taylor, Palec, University, Metrix.

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Melbourne's Wholesale House

two bearings are very accurately made and support a load of 28lb. They are each five inches long and two inches in diameter.

The air film is not established until the shaft is running at 300 r.p.m., and below this speed metallic contact and wear occur. For this reason the bearing materials chosen were Monel metal running on chromium plate—a combination which gives a minimum wearing.

The normal operating speed of the 25 h.p. motor and air turbine is 24,000 revolutions a minute. At this speed the air film separates the parts completely at the low loadings used. A bearing of this kind has been running continuously at Harwell—where the idea originated—without trouble.

Steam cools valves

"STEAM-COOLED" valves are being used in a new set of transmitters for the B.B.C.'s overseas service. These will be the first transmitters made in Britain to use this form of cooling, although it has been available for 25 years. The objection to it in the past was that its apparatus was wasteful in space and complicated in plumbing.

Recent improvements in design have removed the objection. The method is more properly described as evaporative cooling. Water in jackets around the valves gives off steam which is led to an air-cooled condenser and the condensed water is cooled and allowed to return by gravity to the jackets.

The new transmitters, rated at 100 kW each, will be set up at the station at Rampisham, Dorset. They are being supplied by Marconi Wireless Telegraph Co.

Todd-AO makes debut

THE Todd-AO system of film presentation, installed by Philips in a Sydney theatre, is winning high praise from the public and technicians alike.

While the size of the projected picture is normally smaller than available from Cinerama, also being shown in Sydney, it does not suffer the basic limitation of Cinerama of presenting a picture made up of three distinct pieces.

The Todd-AO picture comes from a single specially-designed projector. There are no joins.

Pioneered by the late Mike Todd and the American Optical Company, the Todd-AO system uses a new and larger film, 70mm wide, and with a picture area 3½ times that available on the more usual 35mm film.

This results in a tremendous improvement in definition and, based on the films shown in the Australian premiere, it is photographically virtually perfect, from the audience point of view.

There is no noticeable grain and, in scenic shots, focus is sharp to the limits of the screen area.

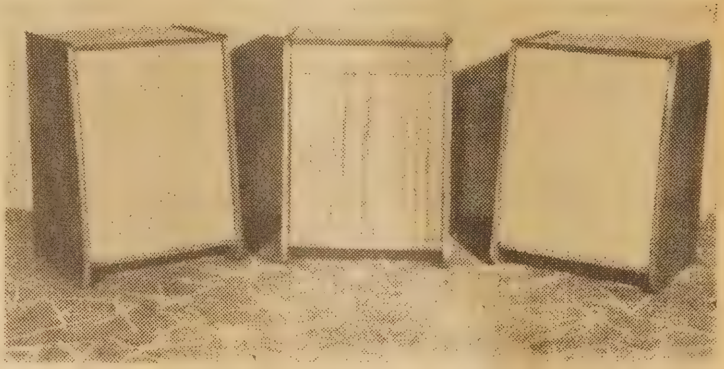
The frame projection rate has also been increased to 2 x 30 frames per second instead of the more usual 2 x 24. Perhaps it is just as well, because the projectors built for it flood the screen with so much light that highlight areas are on the flicker perception borderline!

The sound rate of the presentation has received similar attention and the 70mm film and machines designed for it cater for six separate tracks.

JUST ARRIVED!

STEREOGRAM CABINETS

Further supplies have now arrived of the "G" series cabinets designed to combine low cost with flexibility and style.



Illustrated above, these cabinets are immaculately finished in maple, walnut or rosewood polished timber, matching in size, style and colour.

Dimensions: Height 29in, width 21½in, depth at the base 18½in. Speaker cabinets are covered at front with plastic grille cloth, fully felt lined with provision for acoustic resistance unit and optional tweeter.

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This cabinet, made by the author, to house the new receiver, is identical in overall size to the original "Transporta Six." Colour is beige with a contrasting darker inset panel. Knobs, speaker grille and handle washers are gold in colour.

A New High-Gain Transistor Portable

Following the description of the "Transporta Six" receiver in the August issue, last, we have had many enquiries as to ways and means of increasing its overall gain and making it more suitable for long distance reception. This article discusses the problem in a practical fashion and gives the circuit for a receiver using two IF amplifier stages.

by Neville Williams

THE new receiver, as pictured above, is capable of an impressive performance. Gain and selectivity are excellent, tonal quality is good and the audio power output is much higher than from valve-type portables.

Best of all, the set is cheap to run. With casual use, the single, inexpensive nine-volt battery will last for months on end.

GENERAL DESIGN

But before saying more about the set in particular, it may be helpful to discuss the general background to the design.

As indicated in the descriptive article, the original "Transporta Six" was developed with simplicity especially in mind and to provide a practical introduction for our readers to a full-scale transistor superhet. We were careful to point out that it was equivalent in performance to a simple valve portable and was therefore not recommended for use in remote areas.

To judge by the number of components sold, the circuit "hit the spot" as far as our readers were concerned, and "Transporta Six" receivers were even manufactured for sale around the city under various names.

But, as we said, the release of the simple circuit was a signal for inquiries about one capable of better station-to-station performance.

While a little extra gain might be obtained by handpicking components and by very careful adjustment, a substantial increase in gain can only be secured by the provision of an extra amplifying stage, somewhere in the line-up—at audio, intermediate or radio frequency. In other words, we had to begin planning a "Transporta Seven."

The audio gain in the "Transporta Six" receiver is already very high, and any increase would only cause embarrassment in the way of possible instability, audio hiss and abrupt operation of the volume control.

This narrowed the choice to an extra IF stage or to extra gain ahead of the frequency changer.

SAME PATTERN

Transistor superhets are no exception to the general rule, in that the frequency changer is the greatest offender in terms of signal-noise ratio. After a certain order of IF gain has been achieved, any additional amplification is best secured at the signal frequency — ahead of the frequency changer.

This has long been the pattern in valve receivers intended for other than purely local reception, and it would seemingly be the logical pattern to follow in designing a successor for the "Transporta Six." However, a number of difficulties become immediately apparent.

Firstly, the gain and selectivity which is currently obtained from a single transistor IF stage is rather low by accepted "valve" standards. If only one extra transistor is to be used, one, therefore, has to consider whether it may confer greater benefit as an extra IF stage, rather than as an RF amplifier.

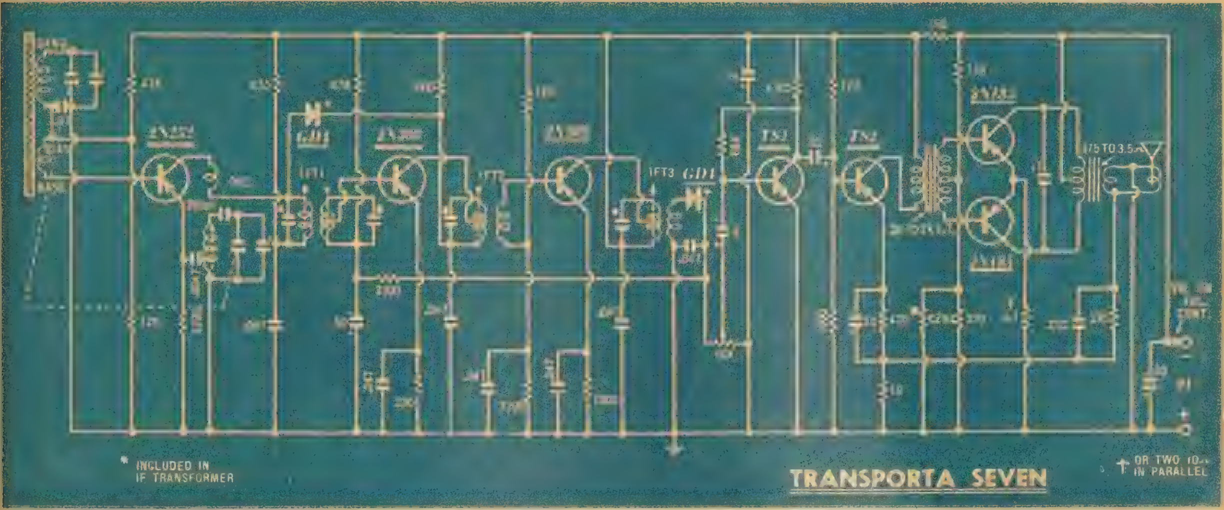
There is all the more point to this query when it is recalled that present-day RF transistors in the "inexpensive, good supply" category approach their natural frequency limit at the high frequency end of the broadcast band.

Secondly, present-day transistors are rather like triode valves in that they exhibit an inconveniently large input/output capacitance. In some cases, neutralisation (or should we say unilateralisation) is essential in high-frequency amplifier service. In others, as in the "Transporta" receivers, stability is obtained only by a discreet choice of transistor and associated circuitry.

Due to the higher signal frequencies involved, it is doubtful whether any or many such transistors could be used as RF amplifiers without neutralisation. This, in turn, presents its own difficulties in signal-frequency circuits, which must be tuned over a 3:1 frequency ratio.

A further point is that amplification ahead of the frequency changer carries with it the responsibility of protecting the last-named against overload on very

TRANSISTOR SUPERHET USES TWO IF STAGES



An extra stage gives this new receiver a big advantage over the original Transporta Six. As explained in the text, an RF amplifier stage might have improved the signal/noise ratio but an extra IF stage has other important advantages. Using a supplementary AVC diode, the control action is very effective, the receiver showing no tendency to overload, even right alongside the stations. Conversely, signals barely audible on the six are loud on the seven.

strong signals. In a transistor set, however, AVC cannot be applied with the same facility as in one using valves.

Each transistor base circuit added to the AVC network consumes power from it and, therefore, reduces the amount of control energy available to other stages. Furthermore, it is not wise to apply AVC to a self-oscillating mixer, because of the danger of putting it out of oscillation.

None of these problems is insuperable but they are of sufficient magnitude to have deterred most designers to date from using a transistor RF stage. Most use two IF stages and accept whatever signal/noise ratio the frequency changer dictates.

It should not be inferred from this, however, that there is any need to apologise for current-model transistor receivers or for the circuit here described.

GAIN IS USEFUL

The extra IF gain is very useful to have and the signal/noise ratio from the frequency changer is only a problem on very weak stations picked up directly on the loopstick aerial. There is not a trace of noise on any local station, barely perceptible noise on stations 50 to 100 miles away, with interstate stations offering at night.

If you are prepared to use a supplementary aerial and earth when holidaying in remote localities, static and electrical interference rather than set noise will be the limit to your listening.

The extra IF stage makes a tremendous difference to the overall gain and selectivity.

But, no less important, it allows a very much better AVC characteristic to be obtained. How, we will see a little later. On test we found that the receiver could be operated within a stone's throw of broadcast station aerials without overloading, being virtually as good in this respect as a comparable valve receiver.

So much, then, for generalities.

In the original "Transporta Six" we were able to present a complete proposition, from the circuit right through to printed wiring boards to suit. This was possible, partly by reason of the simplicity of the set and partly because the several firms concerned had time to work everything out before sufficient transistors and other components became available to warrant its release.

Our part in the matter was to cross-check the design and components, make any necessary amendments and then present the whole story to our readers and to the trade.

The more complex circuit shown this month hasn't been anything like as simple to arrange. From the start there has been a good deal of uncertainty as to optimum circuit practice and we have had to follow our more usual course of working something out for ourselves in order to give a lead.

Of necessity, the emphasis of this present article is therefore on the choice of components and on circuit design. Whether you build something like our prototype or vary it to suit yourself can be a matter of personal choice. Best of all, one of our advertisers may see fit to arrange production of a printed board to suit the recommended circuit.

The circuit itself is a logical derivation from the earlier "Transporta Six," the audio section in fact being almost identical. The original design has proved quite adequate in this respect, although we have come across minor problems in individual receivers, caused by component variations.

One such trouble has to do with the forward bias required to bring the output transistors to just over the threshold of conduction, as required for class B operation. With signal, on alternate half

PARTS LIST

1 Cabinet; internal measurements 9¾ x 6 1/8 x 3 inches.
1 Baseplate 9½ x 5½in.
1 Aerial rod bracket.
1 5in diameter speaker, 3.5-ohm voice coil.
1 Output transformer, 375-ohm CT to 3.5 ohms.
1 Driver Transformer, 3000 ohms to 2,000 ohms CT.
1 2-gang 415pF tuning capacitor.
1 ¼in extension shaft for above.
2 50pF trimmer capacitors.
1 Special coil kit comprising aerial rod and coil, oscillator coil, double tuner, 1st IF transformer, 2nd and 3rd IF transformers. (See text.)
1 Calibrated tuning knob.
1 Volume control knob.
2 GD4 germanium diodes.
1 CZ9A thermistor.
1 10,000 ohm potentiometer with switch (Low "hop-on" resistance type preferred).
1 Printed circuit board, audio system.
1 Piece of punching bakelite 3 x 5-5/8 inches to carry tuner; tubular rivets to suit. (See text.)

TRANSISTORS
1 2N252, 1 2N308, 1 2N309, 1 TS1, 1 TS2, 2 2N185.

RESISTORS—all ½-watt.
1 4.7 ohm or two 10-ohm in parallel.
1 10 ohm.
3 330 ohm, 1 390 ohm, 2 470 ohm.
2 1000 ohm, 1 1500 ohm, 1 2200 ohm.
2 3300 ohm, 1 4700 ohm, 1 10K.
3 12K, 2 47K, 1 68K.

CAPACITORS—miniature types.
1 390 pF (close tolerance for padder).
1 .0047mfd. (plastic), 1 .01, 1 .022
7 .047 disc ceramic (or .05 mfd).
1 .1 mfd. 100v paper.
1 2mfd. electro. 12VW.
4 50 mfd. electro. 12VW.
1 75 mfd. electro. 12VW.

SUNDRIES
Hookup wire, spaghetti tubing, resin cored solder, 9-volt battery (type 3276-P or similar), 2 3/8 ID rubber grommets, 8 1/8in dia. bolts 1in long, nuts, bolts, battery plug.

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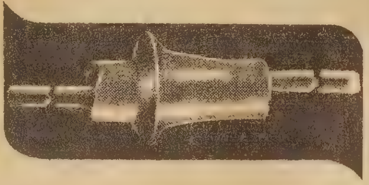

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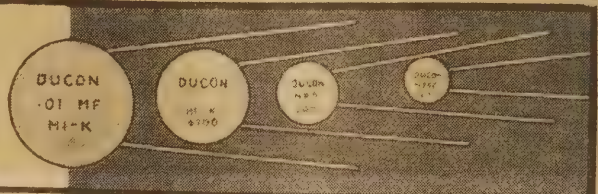
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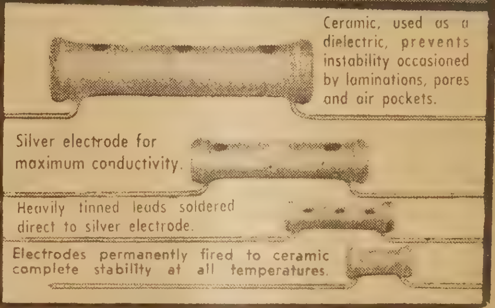

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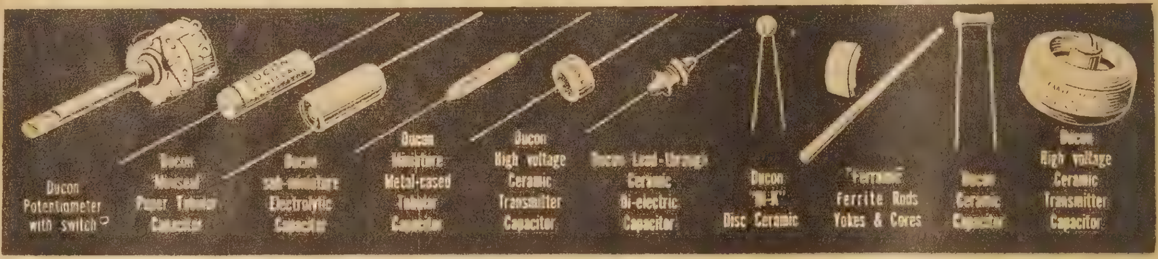
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Ducon Lead-through Ceramic Di-electric Capacitor
Ducon "Hi-K" Disc Ceramic
"Ferramic" Ferrite Rods Yokes & Cores
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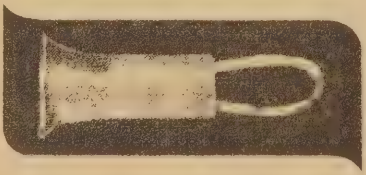

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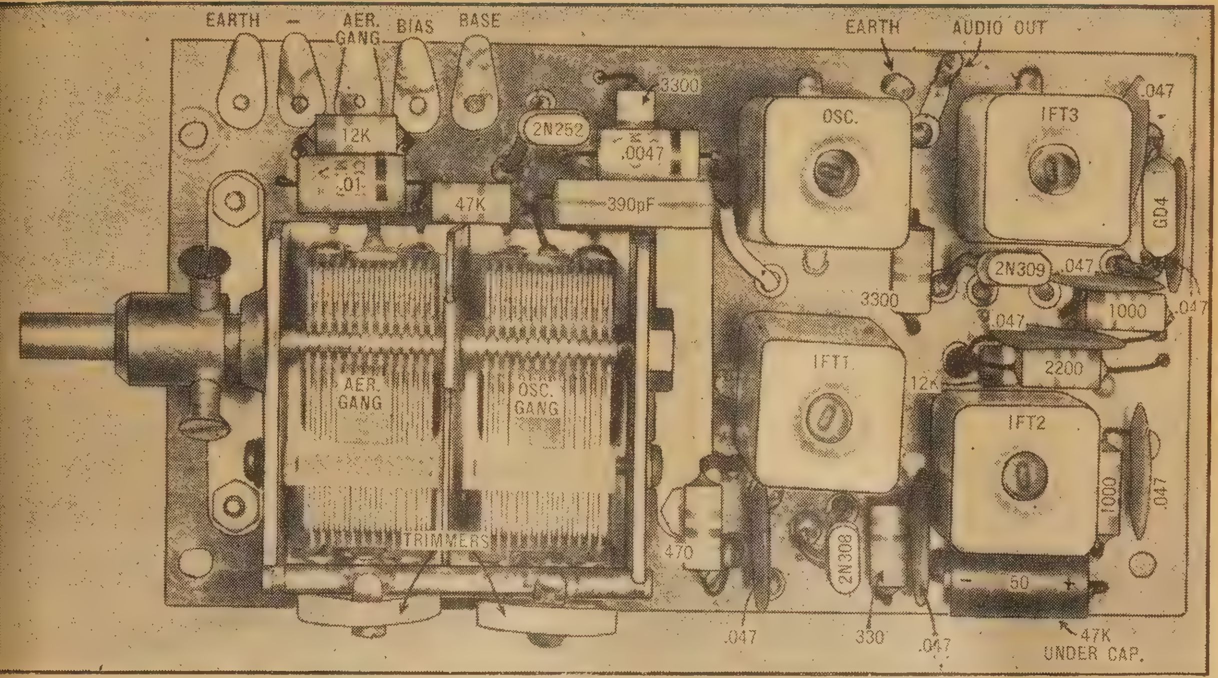
TOP VIEW OF TUNER SHOWS LAYOUT & COMPONENTS



Slightly larger than full size, this photograph shows the components of the tuner section laid out on a piece of punching bakelite. While not actually critical, the placement of parts is important. Wrong placement, incorrect orientation of major components or badly routed leads can readily produce instability in the high-gain IF channel. Loopstick aerial connects to terminals marked "Gang, Bias, Base."

cycles, one conducts while the other cuts off.

If the standing collector current is not quite high enough, distortion occurs of signals having very low amplitude. Thus the reproduction is poor at low volume, seeming to clear up somewhat as the control is advanced. However, even though the loud content of voice and music sounds clean enough, there is a definite "muddiness" or distortion of the lower level accompaniment or background.

COLLECTOR CURRENT

The condition can be verified with a tone source and a C.R.O. or by noting the standing collector current of the output transistors, with no input signal.

If this no-signal standing current is of the order of 0.2 to 0.3 milliamp total, measured at the centre tap of the transformer, it may be worthwhile to increase the forward bias current, sufficient to bring the standing collector current up to between 0.6 and 1 milliamp.

This will involve reducing the value of the original 12K forward bias resistor unning from the 9 volt line to the CT of the driver transformer. The resistor may typically be reduced to 10K or the existing 12K may be shunted by something in the range from 68K to 100K.

In our new circuit, 10K has been recommended initially as the value likely to suit most transistors.

Over and above the matter of initial bias, some transistor output pairs have not been as accurately matched as is desirable and, in a few cases investigated by the manufacturers, this has led to some deterioration in both quality and maximum power output. They are taking steps to see that locally manufactured transistors, in particular, are selected for very close balance.

It must be stressed, however, that this balance may easily be upset by maltreating the transistors, either physically or electrically. No more heat than absolutely necessary should be applied to the leads and, particularly if the leads are shortened, a heat "sink" must be used between the body of the transistor and the end being soldered.

Electrically, the transistors must not be subjected to improper bias or load conditions, or reverse or excessive collector voltage. This includes operating them from a 12-volt car electrical system on the loose assumption that "a few extra volts won't hurt!"

TRANSFORMERS?

Whilst investigating balance, the transistor manufacturers also unearthed the fact that some of the transformers offered for sale are themselves not above reproach. Even allowing for the deliberately inexpensive design, the tappings are apparently not always in the centre of the windings, as turns go, and this makes it appear, to a cursory examination, that the transistors are at fault.

Problems of balance are not likely to emerge, unless you have facilities for checking it but, if you do, the possibility of transformer error must not be overlooked.

More serious than balance, however, is the matter of transformer winding resistance and this is something which most constructors will be able to check for themselves, using an ordinary ohmmeter.

The transistor manufacturers have investigated the matter in relation to class-B amplifiers and recommend that the DC resistance of winding should not exceed 5 per cent of the nominal impedance in the case of a driver transformer and 3 per cent of the nominal impedance in the case of the output transformer.

High resistance in one winding can be compensated in part by lower resistance in another but, in round figures, it would mean that the following resistance figures should be observed for the "Transporta" circuit:—

Driver primary winding, 3,000 ohms impedance, DC resistance not to exceed 150 ohms.

Driver secondary winding, 2,000 ohms impedance, DC resistance not to exceed 100 ohms.

Output Transformer primary, 375 ohms impedance, DC resistance not to exceed 12 ohms.

Output transformer secondary, 3.5 ohms impedance, DC resistance not to exceed 0.1 ohm.

Provided the DC resistance figures are of this order or lower, the power output and general performance of the transistor power stage will be substantially as expected and we have demonstrated as much to ourselves in several receivers which we have handled. As stated earlier, the quality of reproduction is excellent and the power output noticeably higher than from comparable valve portables.

TOO MUCH RESISTANCE

However, a few transformers have been sold with winding resistance figures much higher than specified and the effect on audio performance is quite tragic. The extra resistance represents a straight dissipative loss but, in addition, completely upsets the effective ratio and balance of the transformer under loaded circuit conditions.

Thus, even though the ratio and balance may appear to be correct under

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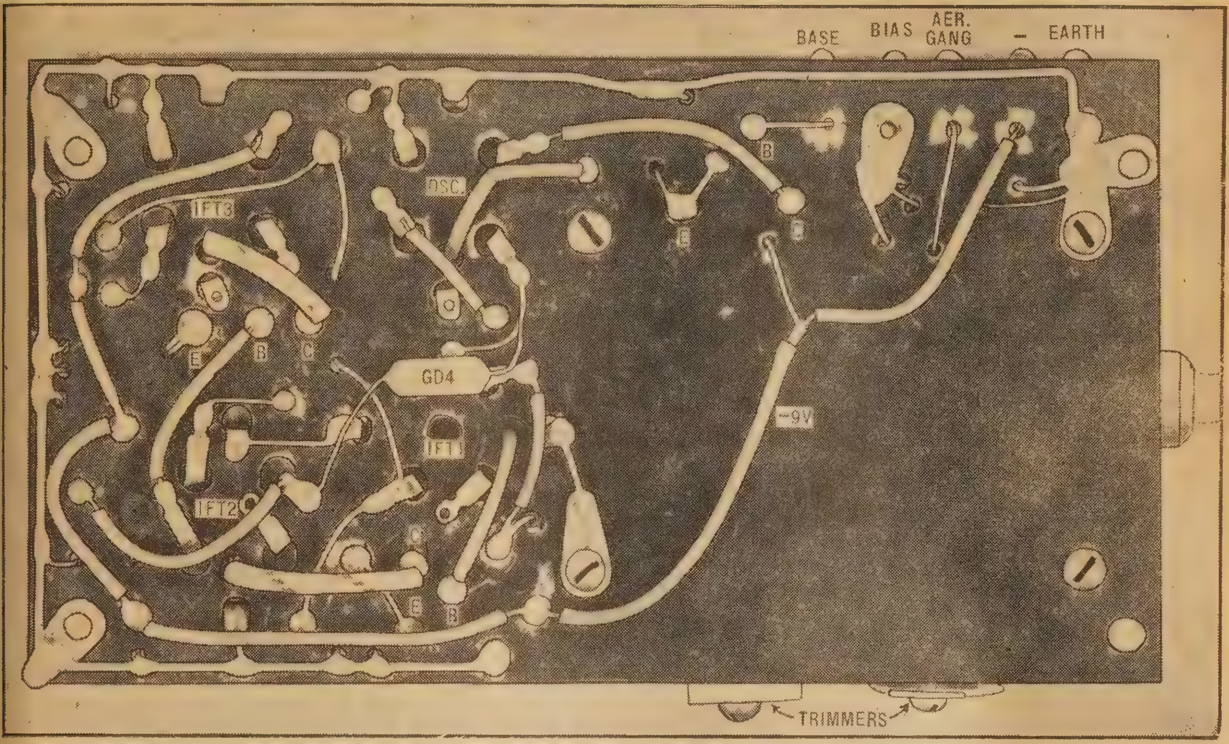
WIRING BENEATH THE TUNER ASSEMBLY BOARD



Again slightly larger than full size, this photograph shows the arrangement of the wiring underneath the tuner assembly board. Layout has been worked out to minimise crossover, so that it would be a good starting point for the development of a printed board. Note that the GD4 AVC diode mounts below IFT1, other positions entailing a long active lead and risk of instability.

open circuit test, both are upset when the secondaries are loaded, in the one case by the transistor input impedance and, in the other, by the speaker voice coil.

If, therefore, you are unhappy with the audio performance of your Transporta Six," and this is seemingly due to transformer DC resistance, we can only suggest that you raise the matter with your supplier. By the same token, it may be as well to check the DC resistance of any transformers you propose to use with our new "Transporta Seven," before wiring them into circuit.

Coming now to the RF end, the circuitry around the 2N252 frequency changing stage is unaltered from the earlier circuit. In the parts list, as before, we have specified a normal 415pF per section capacitor, with high capacitance trimmers to make up for the lower effective shunt capacitance in transistor circuits (due to the base being tapped down the coil).

DIFFERENT INDUCTANCE

At least one manufacturer has released coils with somewhat higher inductance than usual, on the assumption that they will be tuned by a ganged capacitor having a lower maximum capacitance. This is a quite permissible approach, but the constructor should check with the parts supplier to make sure that the gang supplied is for the coils of your choosing.

Coming now to the IF amplifier, the irst stage uses a 2N308, and there are everal points about it which need explanation.

Firstly, the emitter bias resistor has been set at 330 ohms, being the minimum figure which the manufacturer is prepared to recommend at this stage, in order to ensure reasonable immunity from temperature effects. (See September issue, last, for a discussion of this problem.)

The forward bias is provided by a 47K resistor running from the -9.0 volt line to the secondary of IFT1, the same point being bypassed to "earth" of the positive battery terminal. From this point, a 3.3K resistor runs to the junction of the diode detector and the 10K volume control potentiometer.

DIODE CONDUCTS

In the absence of signal, the current through the base bias network passes through the detector diode, which is thus maintained in a slightly conducting condition. This does not appear in practice to have any undesirable effect on the performance of the diode as a detector.

Looking at the circuit from the other end, the diode detector "sees" as its DC load the 10K potentiometer and another path through the 3,300 ohm resistor and the base-to-emitter resistance of the 2N308. There is very little drop across the base-to-emitter circuit, and the net DC load for the diode is virtually a 3,300 and a 10K in parallel, equivalent to a value of 2,500 ohms.

With input signal, current through the 3,300 ohm resistor and through the base-emitter circuit carries the base in a positive direction, effectively reducing the forward bias on the 2N308.

This transistor draws a little less than 1 milliamp under the no-signal condition, at which current the stage gain is about maximum. Reducing the forward bias reduces the collector current and, with it, the stage gain. The 50 mfd electrolytic shown in the circuit effectively removes any audio content from the bias voltage.

On its own, the AVC effect thus obtained might be insufficient for some strong signal localities and the circuit provides for a supplementary control effect. This takes the form of a GD4 diode, connected between the supply point of IFT2 and the collector circuit of the 2N252.

Under weak signal conditions, with the 2N308 drawing full current, there is greater voltage drop across the 1,000 ohm resistor in the collector circuit than across the equivalent 470 ohm resistor in the collector of the 2N252. A small reverse voltage is therefore present across the GD4, which does not conduct and which therefore has no immediate effect on the circuit.

VOLTAGE REVERSES

When an AC voltage produced by a strong signal lowers the current of the 2N308, the voltage drop across the 1,000 ohm resistor becomes less than that in the 2N252 collector circuit and the voltage across the GD4 reverses. It therefore begins to conduct and its forward resistance appears as a substantial DC load across the primary of IFT1, thereby reducing circuit gain.

An important point to remember is that the controlled stage does not have to deliver a large output signal while biased by AVC to near cut-off. With a second fully-operative IF amplifier following, the controlled stage is never

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called upon to handle more than a minimum of signal. It is therefore in a much more favourable position than w feeding directly into the detector di as in the simpler "Transporta Six."

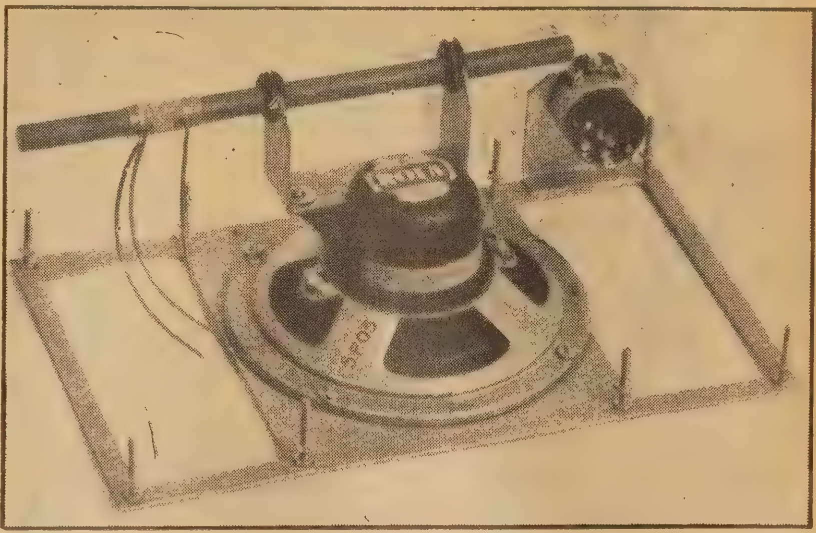
As we stated earlier, the control characteristic of this new circuit is very good indeed, the receiver showing no obvious overload, even when operated within a stone's throw of the transmitting masts and the aerial orientated for maximum pickup.

The second IF amplifier is a 2N309. Actually another 2N308 could have been used in this position but the manufacturers prefer to sell the combination of transistors suggested as a standard fitment for transistor sets with two IF stages.

Operating conditions for this second stage are quite normal and do not call for any special comment.

The performance of the tuner, as a whole, rests very heavily on the design of the IF transformers, their correct choice governing the gain, selectivity and stability. A close parallel exists here between this receiver and one using valves.

BASEPLATE, SPEAKER, AERIAL & V/C



The speaker, aerial rod and volume control are assembled on to a baseplate, as shown, which also holds the two boards, audio on the right, tuner on the left. The tuner described in this article has the same overall dimensions as the simpler type described earlier but it has vastly improved performance by reason of the extra stage.

With two IF amplifier stages, it is not necessary and, in fact, it is undesirable to use transformers giving the highest possible individual stage gain. Adequate gain, better stability and better selectivity are obtained by using windings tuned with more than the usual amount of "C," resulting in lower dynamic impedance but higher "Q."

Typical commercial receivers use capacitance values of up to 330pF to tune the IF transformers, the winding inductance being reduced as necessary to secure resonance.

FIRST VERSION

We built the tuner, first of all, with three single-tuned unity-coupled transformers, tuned by about 200pF capacitors—actually identical with the IFT2 used for the "Transporta Six." The overall performance was very good but we decided that rather more selectivity could well be provided, without rendering the receiver unduly difficult to tune.

However, with a normal double-tuned transformer in the first position, the IF channel tended to be unstable and we arranged with a coil manufacturer to produce a new double-tuned transformer including 300pF capacitors. This provided all the controllable gain we could use and excellent selectivity.

The circuit has therefore been drawn on the assumption that a high-C double-tuned first IF transformer will be used, followed by two single-tuned unity-coupled transformers identical with the IFT2 in the "Transporta Six."

In wiring these transformers, we followed the precedent set by the earlier receiver.

In the case of IFT1, the "hot" lugs are diagonally opposite, as is the usual practice. Thus the "Collector" connects via the oscillator coil to its appropriate lug, while the active end of the other winding is diagonally opposite. In point of fact, this lug is not used externally, since the base of the following transistor is fed from a tapping on this secondary winding.

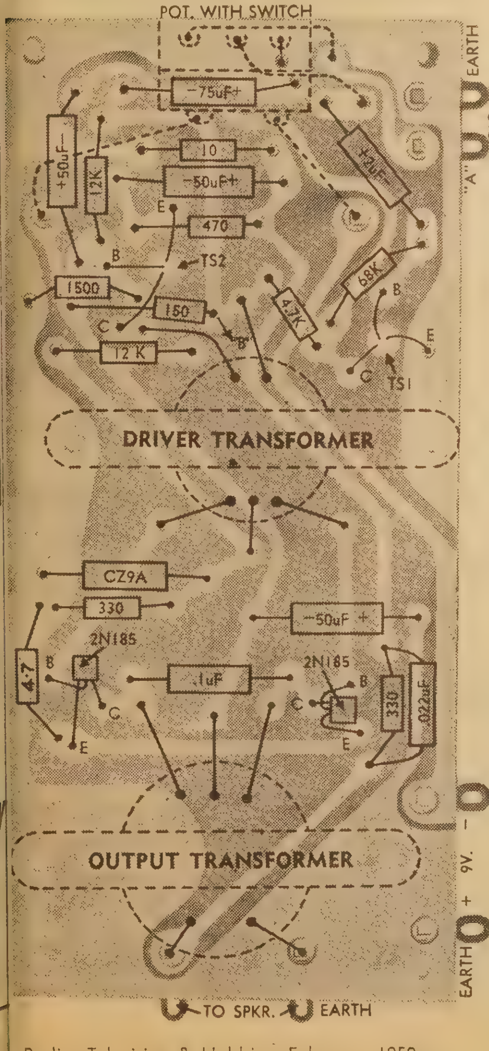
TAPPING POSITION

It is most important that the secondary be connected into circuit so that the base tapping is nearest the low potential or "earthy" end of the winding. This can be verified easily enough by means of an ohmmeter.

Connecting the primary as suggested gives the highest gain, since the magnetic and capacitive coupling within the transformer is then additive. If, for any reason, the gain is excessive and the IF channel is unstable, it is possible to reduce gain by the simple expedient of reversing the connections to the primary winding.

Our experience, however, is that the receiver will be stable in its maximum gain condition, PROVIDED leads are short and components are well placed. The idea that layout doesn't matter in a transistor set could not be further from the truth — at least, as far as a high-gain IF channel is concerned.

In the case of the other transformers, the wiring to the pins follows the same



☆

Reprinted from earlier issues, this diagram shows the standard audio board. We now recommend that the 12K resistor in the bias circuit for the output stage be decreased to 10K (see text). If desired, the audio transistors can be replaced by types OC70, OC71 and two OC72's without change to the circuit. If the OC72's are used their standard heat sinks can be installed with some advantage being soldered to the output transformer bracket. Substitute transistors cannot be recommended in the tuner.

Two Mullard Tubes

Mullard
DG16-22

2¾″ general purpose tube
DG7-5 (CV2175)

The DG7-5 has a low operating voltage and is intended for symmetrical deflection. It is being successfully employed for wave form monitoring and for inexpensive oscilloscopes.

5½″ x 1½″ flat A-scan tube
DG16-22/7APHI (CV2352)

The screen of the DG16-22 measures 5½″ x 1½″. A number of these tubes can be easily stacked to provide multiple displays in confined spaces.

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sequence as established for the same component in the "Transporta Six." We did this to avoid possible confusion and upon the manufacturer's advice that polarity of the secondary does not matter greatly in a single-tuned transformer.

The constructional side of the tuner presented us with something of a problem. As we said earlier, we were not happy with some of the ideas abroad about circuit design and had to develop something to suit ourselves. But this meant, of course, that no printed circuit could be immediately available. Nor were we happy about holding the whole thing up until factories had reopened after Christmas and somebody could decide to do something about it. We felt it better to present the information immediately.

The general layout of the "Transporta" receiver demands that whatever tuner is used, it must be built as flat as possible so as to fit on the metal baseplate. In any case, the absence of valve sockets, which provide so many anchor points in a conventional receiver, makes it desirable to seek an alternative constructional method to the usual metal dish chassis.

TUNER CONSTRUCTION

In our case, we secured a scrap of punching bakelite and proceeded to lay it out and wire it up in the manner of a printed board. Holes were drilled in the appropriate places and small tubular rivets inserted where necessary. The layout was arranged, at the same time, to eliminate all but a minimum number of cross-overs, and, in fact, should provide a good starting point for anyone wanting to devise a printed circuit pattern.

We are hopeful that one or other of our advertisers will see fit to arrange release of a printed board to suit this particular circuit. However, it is impossible to be more definite at this stage, because the closure of factories over the Christmas/New Year period has made it impossible for us to finalise the matter.

In the meantime, anyone desiring to duplicate the original tuner should be able to do so readily enough by a careful study of the two photographs.

METAL BASEPLATE?

Alternatively, if finished dimensions can be arranged to suit, there is no reason why the tuner should not be assembled on a metal baseplate, using tag-strips where necessary to support the wiring, components and transistors.

We must stress, however, that the layout should follow logical lines, without long leads or feedback paths between input and output. The position of the AVC diode is most important, since it constitutes a path between two successive stages. In particular, the lead running to the active end of IFT1 must not be too long or placed where it can cause feedback.

Another important component is the .047 on the —9 volt line. This serves primarily as a bypass for the last IF transformer, and it should be placed with this in mind. Originally, we put it near the front of the board and returning to the earthed gang frame; it was a neat position mechanically, but electrically it promoted instability instead of preventing it.

Remember, too, that the cans of all coils and IF transformers must be earthed.

When finally completed, the tuner and audio sections are mounted on the baseplate pictured herewith, being the same plate as used for the original "Transporta Six." A few connecting wires are necessary between them and the speaker and volume control. The aerial rod can also be installed and connected to the appropriate three lugs on the tuner board.

For additional information, we suggest that you refer back to the original article in the August, 1958, issue and the subsequent article on circuit design in September.

Pending the possible release of a printed circuit board to suit the tuner, one of our advertisers has expressed his intention of making available a suitable piece of bakelite, together with enough tubular rivets for the job.

TUNER ALIGNMENT

Alignment of the tuner does not present any special problems. If an oscillator is available, the IF transformers should be aligned first to 455Kc. Remember that the correct position for the cores in IFT1 is to the outside the respective windings, not passing through them to the centre of the former.

The assembly boards must obviously have a central hole beneath IFT1, to give access to the bottom core.

The core positions for the other two transformers are not critical, since only one unity coupled winding is involved in each and one core. It is a good plan to use some core locking compound to minimise the risk later of the cores shifting with vibration.

If the signal input is kept low, peak output can be judged by ear fairly well. However, at least two positions are possible for metering the effect of core adjustments.

One scheme is to use the output function of an ordinary multimeter, setting it to the 10-volt AC range and connecting the prods between the two output collectors. Actually the ends of the collector leads can be passed through the board and bent over to form stubs on which the multimeter leads will clip.

Increased output will obviously show as increased deflection of the meter.

An alternative scheme is to connect a multimeter, set to the 1-milliamp range, in series with the minus 9-volt end of the 1,000 ohm resistor feeding the 2N308. The collector current will be seen to drop with increasing signal input, so that it becomes a ready indication of the effect of alignment.

CORRECT SETTING

In this case, the correct setting of any core or trimmer is the one which causes the greatest downward swing of the meter.

If no modulated oscillator is available, leave the IF cores alone, for the time being, and transfer attention directly to the aerial and oscillator circuits.

To align the tuning circuits, the dial must be attached to the gang shaft and a piece of stiff busbar or something else suitable mounted against the edge of it to provide a reference point. Set the dial so that the limit line at the low frequency end is against the pointer when the gang plates are fully in mesh.

Now tune a station or signal at about 600Kc and adjust the oscillator CORE until the station position corresponds with the appropriate marking on the dial. While still tuned to the station, push the

(Continued on Page 59)

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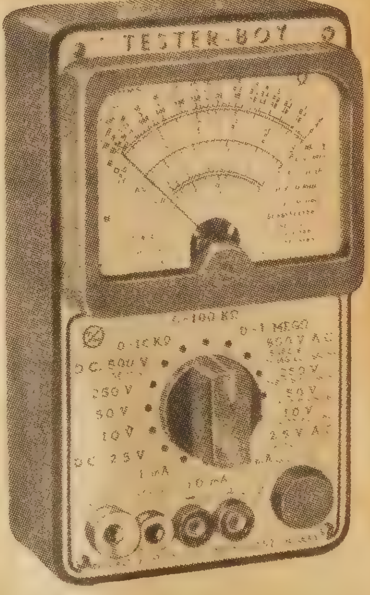

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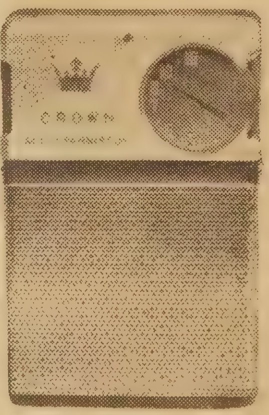

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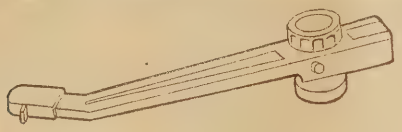

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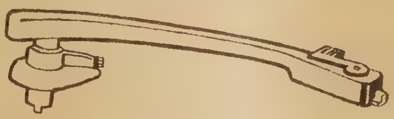

GOLDRING G.60 TRANSCRIPTION ARM

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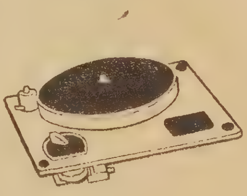
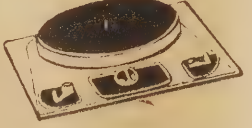
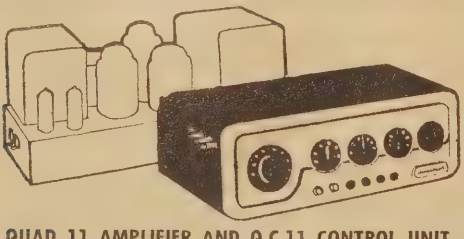


GARRARD 301 TRANSCRIPTION MOTOR



Turntable and mounting plate made in diecast aluminium. Robust induction motor floats on six tensioned springs. Turntable spindle made from high-quality steel, with bearings of cast phosphor bronze. Three speeds adjustable by plus or minus 2½%. Available from stock.



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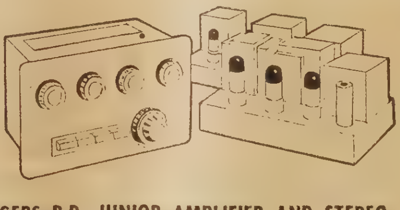

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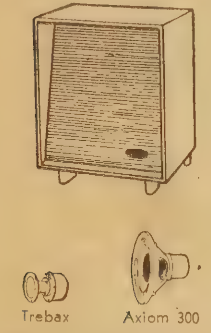

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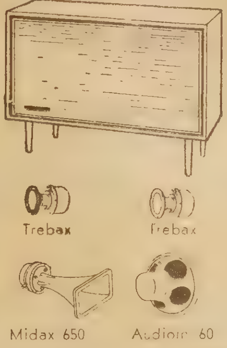

GOODMANS AXIOM 15/4

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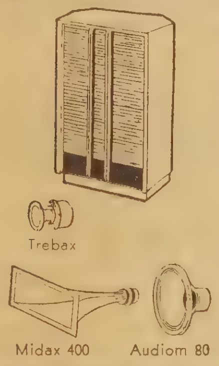
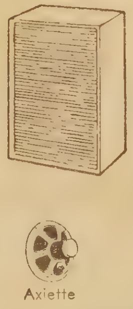


GOODMANS 325

Complete Three-unit High-Fidelity System. Overall frequency range: 30 c/s.-16,000 c/s. Bass Unit: Audiom 80 15" single-cone unit (30 c/s.-750 c/s.). Mid Range: Midax 400 pressure-driven horn unit (750 c/s.-5,000 c/s.). High-Frequency: Trebax pressure-driven horn unit (5,000 c/s.-16,000 c/s.). Capacity: 25 watts. Dimensions: 33" x 22" x 20½".



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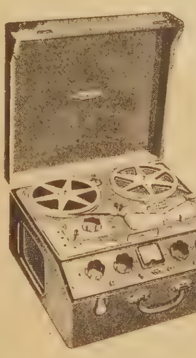

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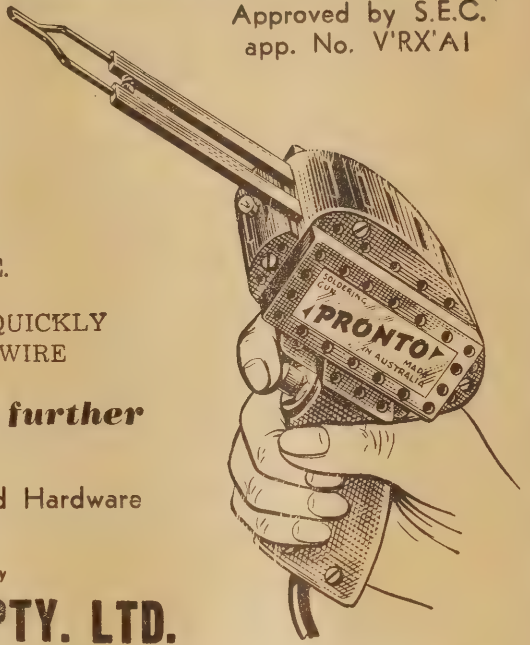

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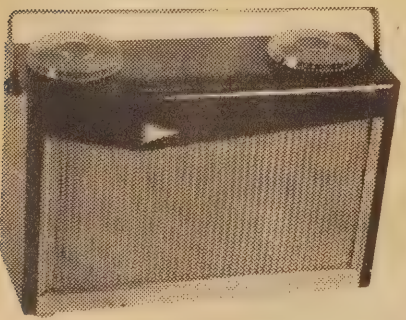

Used as a car radio, the "Transporta 7" connects to a standard car aerial and takes but seconds to unclip and to use it as a powerful, lightweight portable with built-in aerial.

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Part No. 176 First I.F. Double Tuned	11/4
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	£5 15 4

Boxed kit of parts, as above, Part No. 563, £5/5/- (save 10/4). Coils and I.F.'s pre-aligned. Parts list and circuit instruction. All wholesale prices—plus 25% tax.

COIL KITS FOR

either the transistorised portable 6 or the portable radiogram Part No. 560 consist of:—

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Here's your answer, Tom!

It seems that no matter how many times we issue advice, warnings, threats and such like, on the subject of illegal transmissions and the need for an Amateur Licence, the same old question comes up for answer again and again. If Tom's electronic ambitions were to be pursued to the end, he and a lot of his pals would end up in real trouble and the vaults of the PMG's department would be filled with confiscated equipment.

HERE, word for word, is the latest letter to hand from one of our younger readers:

Would a licence be required for a small low-powered one-valve Morse code transmitter, capable of transmitting on the 1.8 Mc, 3.5 Mc and 7 Mc? I would like to use it to talk to my mate down the street.

In one of the very early instalments of "Here's Your Answer, Tom," we had to answer a very similar query, except that, on this occasion, Tom wanted us also to supply a circuit.

Trying to emphasise the point, we had our artist do an appropriate drawing, and this, together with the original answer, is reprinted herewith:

The chain of events would go something like this. We would publish a simple and inexpensive little transmitter. You would worry the life out of your parents until you managed to buy all the parts. Maybe you'd get by with a few substitute bits and pieces from an old set, and use the coils instead of the ones we'd specify.

Then you'd go on the air, and, with a bit of luck, your mate down the road would hear you—but so would a lot of other people in the district. At first they might be amused and tolerant, but after that they would get so mad at the chatter, the whistles, the buzzes that someone would write to the authorities.

Sooner or later someone else would appear with a direction-finding outfit and ultimately they would knock on your door. There would be a Court case, a fine and a lot of nasty goings on, which would take all the fun out of radio for a long time to come.

And we are not kidding, either, Tom. It has happened several times.

There is only one way you can legally operate your own station, and that's to get your Amateur Operator's Certificate of proficiency—better known as your "Ham" ticket—and set up a station in a right and proper fashion.

Even then you can't use many of the simple low frequency transceiver circuits you sometimes see published in overseas magazines. Most of them would wander all over the place (in terms of frequency) and generally behave in such a manner that they would invite the ire of your fellow-hams, as well as the P.M.G. boys.

What is the difference in the physical detail between a voltage amplifying valve and a power output valve?

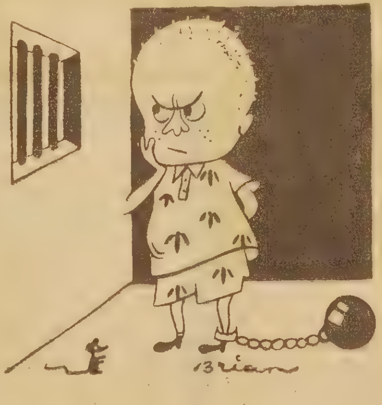
The vital differences between a power output valve and other types are internal and stem from the fact that power valves are normally intended to operate with higher current and higher peaks voltages than ordinary voltage amplifying types. It is, therefore, usual to provide larger and heavier plate, cathode and grids, which are better able to withstand the heat and, or handle the higher current which flows.

In many cases, the glass bulb is also made larger, to lower its surface temperature and make for greater reliability. It is not unusual, therefore, to find that, in any particular series, the power valves are taller or wider than other types.

★ ★ ★

Is there any difference between a speaker transformer and an output transformer? Could one be substituted for the other?

You could probably start an argument on this one, Tom. Some might contend that there is no difference between them, the two terms meaning the same thing. Others might maintain that usage has established a different shade of meaning.



We'll tell you the story and let you form your own opinion.

Dynamic speakers such as encountered in the average set or radiogram require a transformer to match their low impedance to that of an output valve. Because of this they are usually supplied with a matching transformer which is more often than not attached to the speaker frame and referred to as the "speaker transformer."

For purely commercial and competitive reasons these speaker transformers are a compromise design—they are good enough for most purposes but just don't have enough iron and copper in their make-up to ensure really high efficiency and low distortion.

While most designers are content to use these transformers and keep the overall cost down there are plenty of instances where it is considered important to get the very best out of an amplifier or receiver, even if it does entail spending a few more pounds. Hence the use of matching transformers of a more expensive type.

These transformers are considerably more bulky and for this reason are mounted on the chassis. In this position it is more usual to think of them as output transformers, even though they are doing the same job as a smaller speaker transformer mounted on the speaker frame.

The same connections are made to the plates and HT and to the voice coil, but common practice is to refer to expensive chassis-mounting types as "output transformers" and the cheaper variety as "speaker transformers."

In amplifier circuits where a high degree of negative feedback is used it would be impossible to use anything but a high-quality output transformer, because a cheap unit would cause unsatisfactory feedback and oscillation. By and large, therefore, using the aforesaid terminology, Hi-Fi amplifiers are always fitted with special "output transformers."

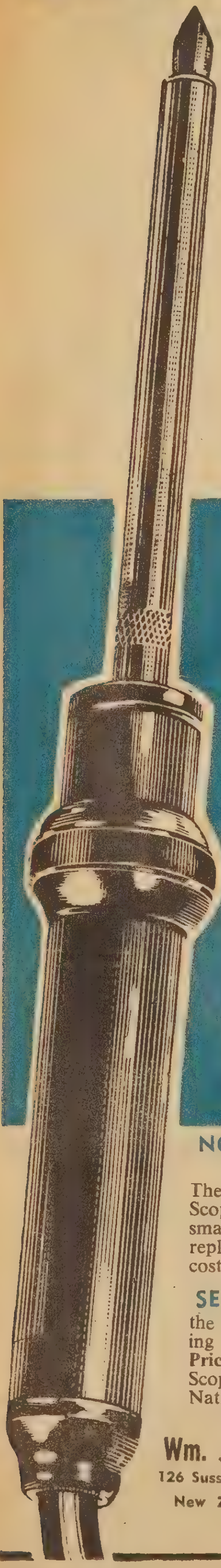
★ ★ ★

Would you please explain why a 6-volt battery has so much less power than a 6-volt accumulator? The apparent difference seems to contradict Ohm's Law, which says the current is proportional only to the voltage and resistance in a circuit.

We agree with you, Tom, that there is an apparent contradiction in the statement of the law when applied to the set of circumstances you mention. If the volts are the same and the resistance in the circuit is the same then the current must be the same — or our friend, George Simon Ohm, has something to answer for.

However, what appears to be and what is are two different sets of conditions. You have overlooked one essential point—namely, battery resistance.

No wrist fatigue with SCOPE



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All voltage sources, batteries and generators alike, have a certain internal resistance, made up by the wiring or the chemicals which compose their innards.

The internal resistance of a freshly charged accumulator is quite low, and it continues to deliver something very close to its nominal 6 volts, irrespective of whether you connect across it a dial lamp or a string of heavy car globes.

Even if you were to press the starter button in the car and draw something like 100 amps. from the poor battery, it still manages to deliver a reasonable voltage. But, in the dry cell the internal resistance is quite high, amounting to several ohms, depending on the size of the cell.

For the sake of argument you may connect up four dry cells in series and find that their added voltage totals 6 volts. However, what you do not know is that the internal resistance could add up to something like 12 ohms.

If you now wish to exercise your knowledge of Ohm's Law, short circuit the terminals and you will find that the maximum current which could flow is 6 divided by 12 which equals .5 amps. We have applied Ohm's Law to the internal and unseen resistance.

Reverting to the actual operating conditions, we find that the current which actually flows is equal to the nominal voltage divided by the total internal and external resistance. In practice, you can never be quite sure of the internal resistance. You simply get to know that cells of certain size can only be expected to deliver load current up to a certain figure. As the cell ages and dries up, the internal resistance increases until the voltage under load is insufficient for your requirements. You then simply say that the battery is "flat" and buy a new one.

* * *

What is a doublet aerial and must it be used with coaxial cable?

A doublet aerial, in the usual sense of the word, is a length of wire or rod broken and fed in the centre and equal in overall length to 95 per cent of the wavelength at which it is supposed to operate.

Amateurs use doublet aerials extensively. An aerial for the 14 Mc band (20 metres), for example, would be approximately 33ft overall.

Doublet aerials work properly only on or very near the frequency for which they have been cut, although they can be made to operate on certain harmonics by special feed arrangements. At all other frequencies the true doublet effect disappears and there is no special advantage over an ordinary aerial.

What we mean to say, Tom, is that the doublet aerial is good for transmitting and listening on a certain narrow band of frequencies, but for general listening on all frequencies it would be best to stick to the old inverted L aerial.

But a word about the cable.

Let us assume for a moment that the doublet aerial is to be used at its natural resonant frequency. The impedance at the centre will be about 70 ohms and a correct match between aerial and the receiver or sender will only occur if the connecting line has a similar impedance.

Once upon a time amateurs used ordinary twisted lead, but nowadays one can buy special RF cable in a variety of impedance values, including 70 ohms.

It is also possible to buy 70 ohm coaxial cable and, as far as impedance values are concerned, the match will be satisfactory for most purposes. Actually some unbalance will occur due to the cable being inherently unbalanced, since one conductor is within the other. A number of clever schemes have been evolved to correct the unbalance, but they do not concern us at the moment.

* * *

Please do not laugh at me but is there such a thing as a sausage aerial?

We assure you Tom, that we have no cause to laught at you, for humorous as the term may seem it is actually an aerial and is synonymous to the cage aerial.

This type of aerial is characterised by a high capacitance and a low R.F. resistance. It consists of a number of parallel conductors spaced in cylindrical fashion, and supported by means of hoops. In some instances the cage construction is applied only to the horizontal member of the aerial, but in others the lead-in is also in cage form.

Elaborate aerials like this were fairly common in the late 20s but experience showed that any advantage they had was so slight that the complication was not justified.

* * *

I have seen sets with two speakers, one large and one small. Are they the woofer and tweeter combinations one often sees mentioned in amplifier articles?

Ideally the answer to this question would be "yes" but we can't help being a little hesitant.

A woofer implies a speaker designed to handle low notes only—usually their upper range is limited to about 5 Kc. On the other hand a tweeter is a treble unit designed to handle frequencies from approximately 5Kc upwards.

The bass speakers are generally big, 12 or more inches in diameter and are capable of developing plenty of power in the bass register. The tweeter on the other hand may be a much smaller and lighter affair, as it is required to produce very little power in the treble register.

It does not necessarily follow that all big speakers are bad in the treble register and that all little speakers are suitable for tweeters. As a matter of fact some of the smaller speakers are poorer at all frequencies than their big brothers. Thus the mere use of two ordinary speakers does not guarantee a wide frequency response.

The best it can offer is a certain broadening of the sound source and possible advantage from separating the high and the low frequencies. Technically it may be said that there is less intermodulation distortion—less mixing up of the high and the low notes.

This, of course, assumes that the designer has genuinely separated the audio signals into the low and the high frequencies and has fed them to the appropriate speakers.

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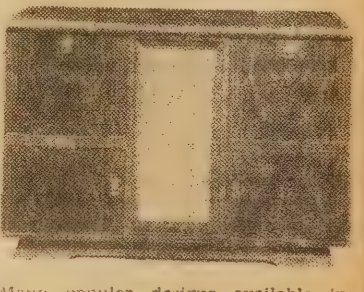

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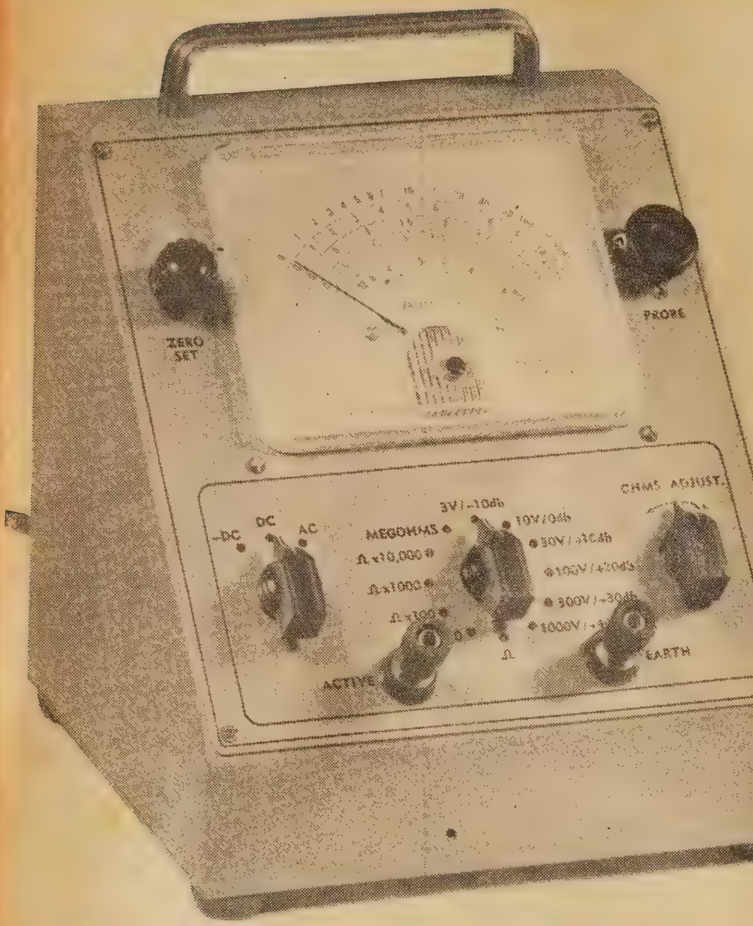


Here is last month's VTVM fitted with a ready-made engraved label. Made to our specifications, and finished in three colours, it provides a professional finish for the completed instrument. It is substantial enough to replace the original plain panel.

Probes For Your VTV Meter

Last month we described what looks like being an extremely popular Bench Type VTVM; compact, simple to build, and easy to use. This month we describe a high voltage DC probe and two AC probes to go with it. Any one of these will increase the usefulness of the basic instrument.

by Philip Watson

FIRST, however, we will have something more to say about calibration which we were able to mention only briefly last month. It is worthwhile going to some trouble in this regard, since the instrument will be no better than the standard against which it is calibrated and the care with which the job is done.

SUITABLE STANDARD

The standard will need to cover the three-volt and 10-volt ranges only for DC calibration, but will need to cover all ranges on AC. If a 1,000-volt range is not available, or 1,000 volts is difficult to obtain, reasonable accuracy may be obtained by calibration at half-scale.

In addition to the standard, a reasonable supply of half watt resistors should be on hand, in the ranges indicated in the circuit as likely values. Some readers may prefer to make preliminary experiments using old pots as variable resistors to indicate the order of resistance required. In any case, it is unlikely that more than two resistors will be required for any one value.

DC voltages of three and 10 will be required for the DC calibration and, if higher values are also available they would be useful. For the AC ranges a supply extending to 1,000 volts is really required but, if this value is difficult to obtain, the highest range could be adjusted with reasonable accuracy at the mid point from a 500-volt source.

A source of DC should not present any serious difficulty, since dry batteries or accumulators to make up at least 10 volts will be perfectly satisfactory. The exact voltage required is obtained by means of a potentiometer connected across the battery, with the voltage picked off between one side and the moving arm. Something between 1,000 and 10,000 ohms will be suitable.

DC ADJUSTMENT

On DC the 10-volt range should be adjusted first, and this should require approximately 1,000 ohms in the "DC Calibrate" circuit. When the exact value has been found, the three-volt range should be adjusted, this requiring something between 150 and 200 ohms. The remaining DC ranges should now be correct automatically within the accuracy of the divider network.

However, if facilities are available, the higher ranges may be checked and any slight inaccuracies noted. Then, if it seems desirable, the "DC" Calibrate" resistors may be varied slightly on a compromise basis. In this regard, it should be realised that a range accurate to within 2 p.c. is normally considered satisfactory, and that it is better to have all ranges within 2 p.c. than one or two "spot on" and others out by, say, 4 p.c.

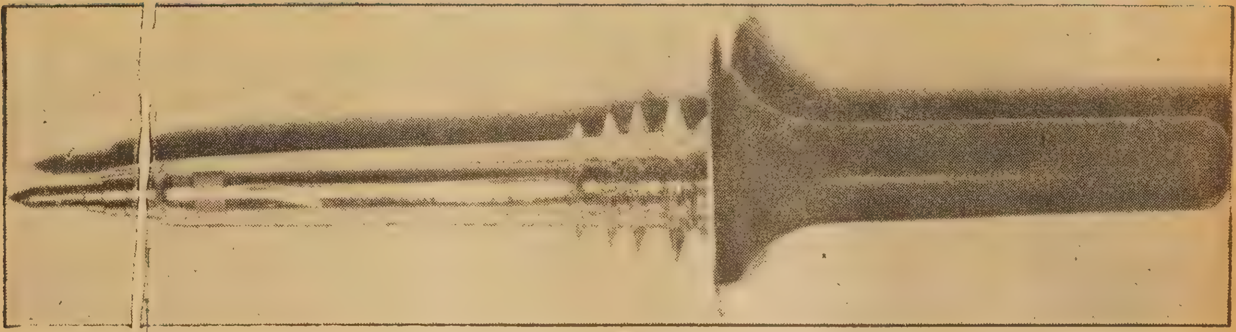
The AC ranges are a bigger job, since each range must be calibrated individually. One or more power transformers form about the best source of supply and most readers should have no difficulty in borrowing suitable types if they are not otherwise available.

AC SUPPLIES

The filament windings, either singly or in series, will cover the three and 10-volt ranges, while the HT winding, either half or full, will supply most of the higher voltages. A 150 volt type will cover the 30, 100 and 300 volt ranges, while a 285 volt type will provide 500 volts for the top range.

For these higher voltages we suggest using two potentiometers in series. One may be the one already used for the lower ranges and the other about 10

EHT PROBE AND TWO HF AC PROBES FOR VTVM



The EHT DC probe for use with TV receivers. The special 990 meg. resistor may be seen inside the transparent plastic probe. Construction is relatively simple.

times this value. The voltage is applied right across the two units, and each moving arm becomes one side of the supply to the meters. The high value pot. will function as a coarse control and the lower one as a fine control.

Take care that the combination of transformer voltage and resistance does not result in serious overload of the pots. These are generally limited to 2 watts dissipation for wire wound, 1 watt for carbon. This is over the entire element and, if in doubt, extra resistance should be added in series to limit this.

CONTACT POTENTIAL

As each AC range approaches correct calibration, resistors should be selected for the contact potential compensation circuit. (See). These are simply selected on the basis of making the meter return to zero.

Do not be afraid to check, and double check, each stage of calibration. It is surprising how many small errors can creep into a job like this unless one is careful and methodical. In particular, make sure that the zero on both meters is correctly set, and check this before every important adjustment.

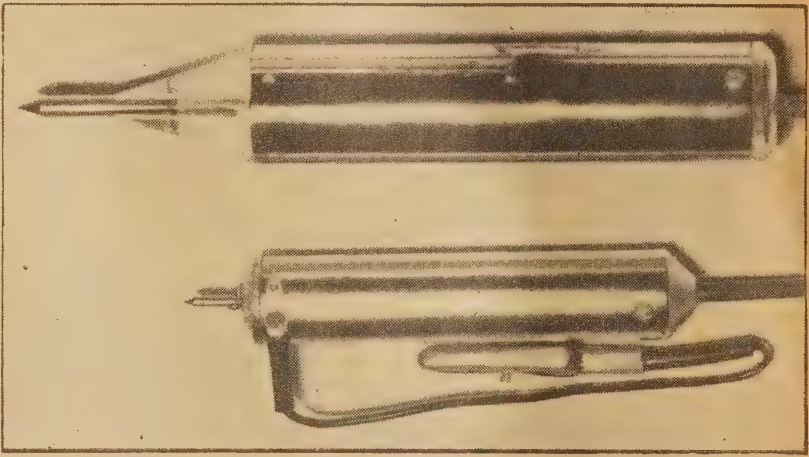
Also, remember that all resistors are likely to be affected to some extent by heat. A resistor strung temporarily into circuit on long pigtails may have quite different resistance when these are cut short and the unit soldered in place a second time. It is wise to hold such leads with long nose pliers to serve as a "heat sink" to minimise this effect. Leave the pliers in place until the joint has cooled appreciably.

In the event that you plan to make either of the AC probes to be described later, it would be as well to wait until these are ready, so that full use may be made of a single set up of equipment.

PROBE TYPES

Coming to the probes, there are three types to be considered; a high voltage DC probe, a valve type AC probe having the same ranges as the instrument and good to about 30 Mc., and a crystal diode probe limited to about 30 volts but good to 200 Mc or so.

We will consider the high voltage type first, and this will almost certainly have the widest appeal. Its main job is that of checking the EHT supply in TV receivers. These varying from 10 to 20KV in typical cases, with the possibility of somewhat higher voltages in the future. It will be equally suitable for use with the Senior VTVM, since the input circuits of both instruments are identical.



The two AC probes. The larger one is the valve type, the smaller the germanium diode. Although limited to 30 volts rms input, the latter can measure voltages with reasonable accuracy up to 200 Mc.

Considering the requirements, and the fact that the range will have to be a multiple of either 3 or 10 to suit the scale, a range of 30KV is a logical choice. With readily available components it is possible to make what is really a "100 times" multiplier, so that the instrument will have a full scale deflection of 30KV when it is set to 300 volts.

PARTS LIST

EHT PROBE

1 EHT probe housing, complete with assembly spring.
1 990 megohm resistor 2 p.c. tolerance.
3ft PT9M co-axial cable.
1 pr. tip jack plugs (suit meter sockets), red and black.
1 Alligator clip.
Brass washers, 5/32 x 7/16.
Insulating bush, shim brass, hookup wire, 4 mm. tubing etc.

VALVE PROBE

1 Large probe housing.
1 6AL5 valve.
1 Miniature 7-pin socket, ceramic or mica filled.
1 Insulating pillar 1in x ¼in, tapped 1/8 Whit.
3 .01 mfd tubular ceramic capacitors.
½W high stability resistors to make 4 meg. approx. (See text.)
1 Miniature 4-pin speaker plug.
3ft 4mm or 5mm tubing.
3 3ft lengths hookup wire, including 1 length 5/.0076 or similar.
Nuts and bolts, solder lugs, shim brass, etc.

GERMANIUM DIODE PROBE.

1 small probe housing, complete with insulating strip.
1 OA85 germanium diode.
1 680 pf Hi-K ceramic capacitor.
1 470 pf Hi-K bead type ceramic capacitor.
½W high stability resistors to make 4 meg. approx. (See text.)
3ft PT9M co-axial cable.
1 Miniature 4-pin speaker plug.
1 8BA x ¼ RH brass screw.
Shim brass, 4mm tubing, etc.

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P/N 263	6 holes	x	36in ..	16/
P/N 264	7 holes	x	3in ..	2/5
P/N 265	7 holes	x	6in ..	4/11
P/N 266	7 holes	x	9in ..	7/
P/N 267	7 holes	x	12in ..	9/7
P/N 268	7 holes	x	36in ..	15/8
P/N 269	9 holes	x	3in ..	2/6
P/N 270	9 holes	x	6in ..	4/11
P/N 271	9 holes	x	9in ..	8/2
P/N 272	9 holes	x	12in ..	10/1
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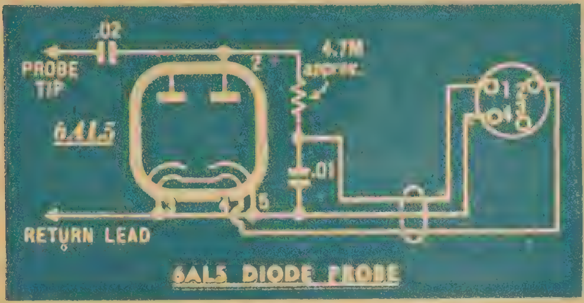
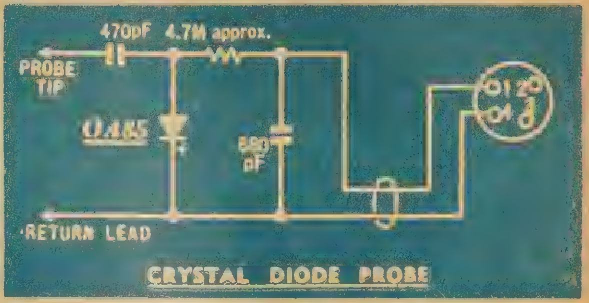


The circuit of the valve probe. Final value of the resistor must be determined experimentally. Major portion should be composed of high stability types.



The circuit of the germanium probe. Note the small input capacitor designed to minimise input capacitance. Resistor value is chosen as for the valve probe. Marked end of OA85 connects to earth side.

However we are not limited to this range. The 100V and 30V ranges become 10KV and 3KV respectively, and these will be extremely useful in checking the EHT on conventional CRO's and experimental TV receivers, where voltages up to 5KV are frequently encountered.

The 10V range naturally becomes a 1,000V range, which is already covered in the instrument itself. However, the higher impedance of the circuit could be valuable on occasions.

CAUTION

At the other end of the scale the 1,000V range becomes, theoretically, a 100KV range. However, voltages requiring such a range are unlikely to be encountered, plus the fact that there may be some doubt as to the ability of the insulation to withstand such pressure. At most, such a range should be used to check a voltage which may be slightly outside the scope of the 30KV range, and then only if extreme caution is exercised.

Electrically, this probe is delightfully simple. It is merely an external resistor connected in series with the active lead, so as to form a voltage divider in conjunction with the 10 meg. resistance network within the instrument.

In practice, however, it is a little more complicated than that. The resistance required to give 100 times multiplication works out at 990 megohms — a lot of resistance no matter how one looks at it. Any suggestion of making up this value from standard resistors is quite out of the question. Even using the highest practical values of resistance, the resultant string would be completely impractical in the physical sense, while each resistor would probably have much more than rated voltage applied across it.

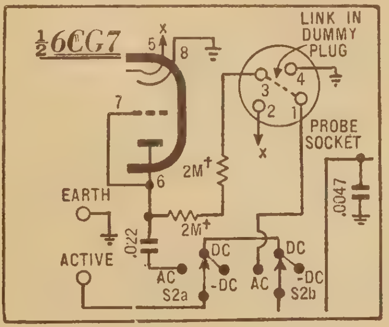
SPECIAL RESISTOR

The only possible approach is to use a resistor specially made for the job and these are normally available, at least to special order. Unfortunately, they are not cheap, costing several pounds, but this is unavoidable, considering the manufacturing processes involved and the standard of accuracy required.

The one we used was supplied by W. J. McLellan, but other makes which may be available, either now or in the future, should be just as suitable. It is 6in long, 5/16in diameter, and fitted with axial screw terminals and solder lugs. It is supplied with a protective plastic cover, and it would seem to be unwise to remove this or to allow the actual resistance element to be handled in any way. The accuracy is given as 2 per cent.

Having obtained the resistor, the next thing is to house it in a suitable probe, remembering the order of voltages with which it is likely to be used.

Although, initially, we had some ideas about constructing such a probe from plastic tube or rod, we soon realised that it would present a number of practical problems, particularly to those readers with limited facilities. Any lingering ideas we might have had vanished when we discovered a ready-made probe incorporating many worthwhile features which it would be difficult or impossible to provide in a homemade version.



Modifications to main instrument to provide more complete isolation of internal diode when probes are in use. Note altered link in dummy plug.

This is made by University Graham Instruments Pty. Ltd., who have agreed to make it available to our readers. The price (approx. 15/ plus tax) is probably little more than one would spend on materials for a home-made unit.

The unit is made in two parts, the probe proper which houses the greater length of the resistor, and the handle. The two screw together with a metal disc between them to serve as a guard ring. This latter is earthed when in use, and serves to guard the operator in the event that his hand should stray too close to a high voltage terminal. At the same time it tends to discourage fingers from finding their way down the probe proper into a dangerous position.

To provide an earth connection for the guard ring it is desirable to use a shielded cable, and PT9M co-axial cable is light, flexible, yet well protected against normal wear and tear. Since nearly all the voltage being measured is applied across the 990M resistor, this cable does not require anything special in the way of insulation. For example, when measuring 30KV, the voltage across the cable will be only 300.

EARTH LEAD

At the instrument end, the cable is terminated in two plugs similar to those used on the regular test leads, the braid connecting to the earth (black) terminal and the central conductor to the active (red) terminal. Also connecting to the black plug is a length of lead terminating in an alligator clip. This is an earth lead which should be connected to the earthy side of the equipment under test, in case there is no direct connection via a common mains supply.

The 990M resistor is held in the probe housing under light spring pressure, and this is really all that is needed to ensure adequate electrical connection at each end. After all, with 1,000M in circuit a few ohms contact resistance is not likely to prove significant. On the other hand the absence of a direct connection makes the assembly of the two sections a good deal simpler, particularly when the need to make connection to the guard ring is considered.

ASSEMBLY

A suitable spring will be supplied with the probe, and the accompanying drawing will show how this is used. The insulating bush is made from a scrap of insulating rod or tube, about 3/8in diameter, ½in long, and with a bore large enough to accommodate the centre of the co-ax. A small washer (5/32 x 7/16) is fitted at the other end of the spring to provide a firm support against the rear of the handle.

The earth braid may be connected to the guard ring by simply passing it along the slot in the probe thread, turning it up, and allowing it to jam between the ring and the moulding. Alter-

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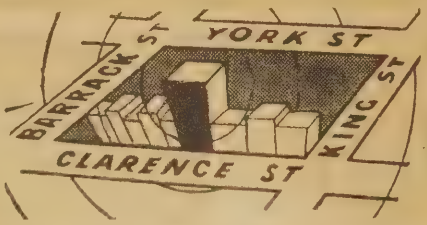

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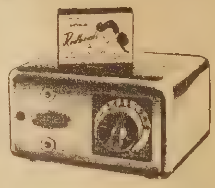

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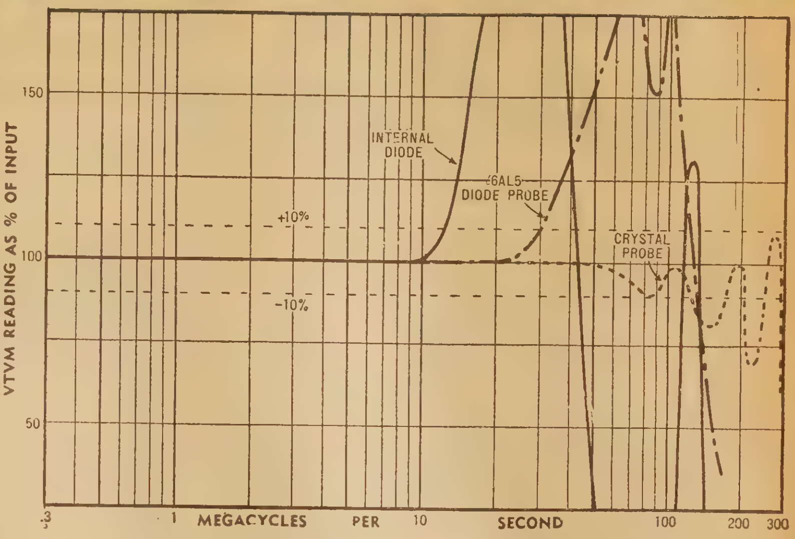
natively, it may be soldered to a suitable washer which will make contact with the guard ring over the entire circumference. We cut such a washer from a scrap of shim brass, and it measures 7/8in. x 1-1/8in.

In separating the central conductor from the outer braid at both ends of the cable, it is suggested that the braid be pushed back as far as possible, the strands separated to form a hole, and the conductor pulled through this hole. This avoids loose strands and makes a neat finish.

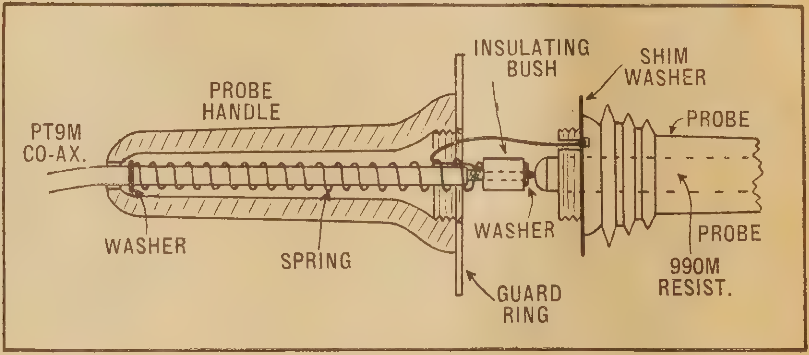
When fitting the plugs at the instrument end, it is suggested that about three or four inches of outer covering be stripped off, and the centre conductor pulled through the braid as already described. Now take the short length of outer conductor previously removed, force about 1½in of push fit plastic tubing over it, and replace it over the central conductor.

Cut it just short enough to allow the plug to be fitted, then force the plastic tubing forward into the rear of the plug so as to make the whole assembly a tight fit. A similar technique may be adopted for the earth lead, particularly if it is felt that the latter can be extended somewhat, as may be required for the wide spacing of the Senior VTVM terminals.

PERFORMANCE OF AC PROBES



This graph shows the general order of performance to be expected from the internal diode and the two probes. Note that this takes no account of the effect the probes may have on high impedance circuits.



Showing how the spring is used in the handle to hold the 990 meg. resistor in place. Note the shim washer used to ensure good contact between the earth lead and the guard ring.

THE AC PROBES

The two AC probes are really only slight modifications of the probes previously described for the senior VTVM (February, 1956). For those who may be interested in the finer points of design, we would refer them to this article. We will confine ourselves to a brief discussion of what each is intended to do and how this is achieved in practice.

The valve probe is really a duplication of the circuit already used in the instrument for the AC ranges. However, by reducing the length of lead from the circuit under test to little more than the length of the probe tip, the loading on the circuit (mainly capacitive) is markedly reduced.

A typical application is the checking of frequency response of high-quality audio amplifiers. In order to check the performance thoroughly, it is often necessary to measure the response at frequencies as high as 100 Kc. or even higher, and the combination of long leads and high impedance circuits at these frequencies may result in significant errors.

In short, wherever there is any doubt concerning possible loading effects, regardless of frequency, the valve probe will be a safer proposition than long leads direct to the meter.

HIGHER VOLTAGES

The fact that voltages up to 1,000 (rms.) may be measured is also a useful feature in such applications, since values approaching this are frequently encountered in the output circuits of high power amplifiers.

Less likely applications, but useful none the less, are measurements of RF in amateur transmitters where, once again, the voltage range would enable most, if not all, stages to be checked.

Where combinations of impedance and frequency are such that the amount of capacitance in the circuit is critical to within a few pf., even the valve probe may load the circuit unduly. In such circumstances the crystal diode probe is a much better proposition since, by careful construction, its input capacitance can be reduced to around two or three pf.

One typical application is the measurement of response of video amplifiers in a TV receiver. Such circuits are very critical in regard to stray capacitance and that which is unavoidable must be offset by resonating with suitable chokes. Any measuring device which added more than a few pf. would be intolerable.

Assuming the availability of such a probe, anyone having a good quality service oscillator capable of delivering a level output up to five or six Mc. would be able to make such response measurements.

Another very valuable application concerns observation of local oscillator activity in transistor superhets. It is difficult to measure this activity by observation of collector current or other DC conditions. However, the actual oscillation may be measured directly across the tuning capacitor with virtually no disturbance of the circuit. (For further details, refer September, 1958, issue, page 63.)

Unfortunately, these excellent facilities are not achieved without some disadvantages. In deliberately keeping the input capacitance low, we prejudice the low frequency response below about 10 Kc., while the characteristics of the germanium diode limit the voltage which can be handled to about 30 rms.

However, provided these limitations are fully understood, and the right probe selected for the right job, they cannot be regarded as serious disadvantages.

As can be seen from the accompanying graph, the valve probe has no serious errors up to 20 Mc., and is still within 10 p.c. at 30 Mc., but is virtually useless above this point.

200 Mc

The germanium diode probe extends to 50 Mc. without appreciable error, and holds within plus or minus 10 p.c. to 200 Mc. or higher.

It must be emphasised that these figures apply only to the probes themselves but take no regard to the effect the probe may have upon the circuit under test. High-impedance circuits still could be seriously loaded even at moderately low frequencies, and each set of circumstances will have to be judged on its merits.

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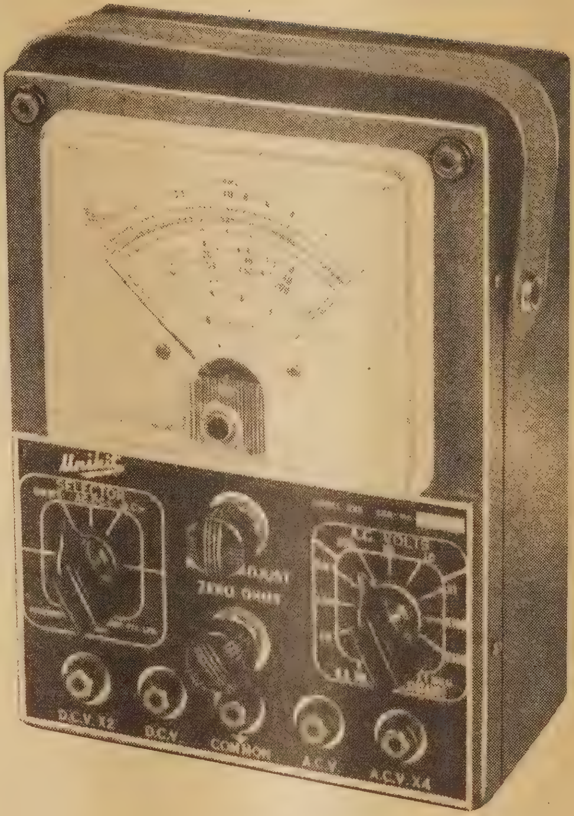

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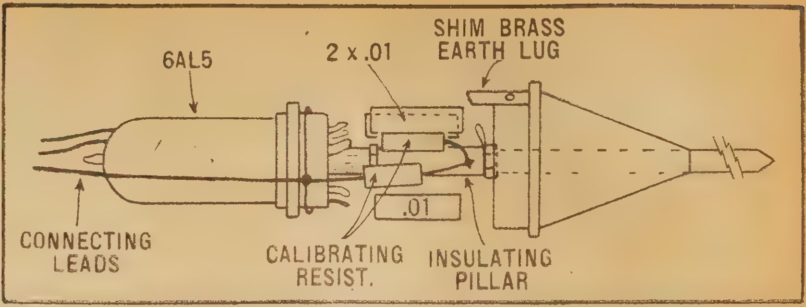
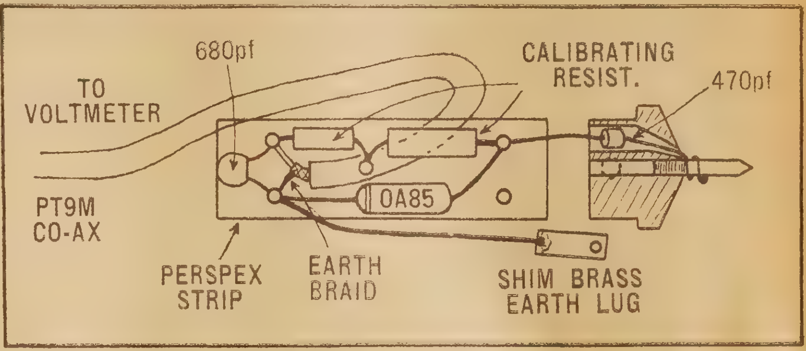


The valve probe uses an insulating pillar on which to mount the valve socket. There is ample room for the few components required. Note the shim brass earth lug



Most of the components for the germanium diode probe are mounted on a perspex panel supplied with the housing. Note the position of the input capacitor.

Reference to the circuits will show that the germanium diode probe is identical with that used for the Senior VTVM, but that the valve probe has been modified somewhat. In the original probe both halves of the 6AL5 were used in a balanced arrangement to duplicate the balanced circuit within the instrument. This is not possible with the simplified circuitry used in this instrument, and one half only of the valve is used.

This leads to a minor limitation in the matter of contact potential effect. While it is possible to compensate for this within the instrument, this facility cannot be extended to the probe unless it should happen that the contact potential of both internal and external diodes is identical. (It might be worthwhile trying both halves of the 6AL5 and selecting the better of the two.)

OVER-CORRECTION

In the case of the crystal diode there is no contact potential generated, but the correction circuit within the instrument will still operate and cause a zero shift because there is nothing to correct.

While this is a limitation, we feel that it is justified, both by the simplicity of the instrument and the fact that AC probe operation will represent only a small proportion of normal usage. It simply means that the zero must be checked whenever the probes are used and adjusted by means of the "Zero Set" control. The effect should not be confused with grid current effects, which are completely absent.

Another problem we encountered concerned the effect of the internal diode on the operation of the probes. In previous circuits we have rendered the diode inoperative by simply using a dummy plug to complete the cathode circuit, this being opened when the plug was removed and the probe fitted.

While this has worked well enough in the past, we did encounter a rather puzzling side effect in this case. It took the form of a false zero immediately after any substantial reading on the meter, and which lingered for several minutes. Unless recognised it could lead to an incorrect resetting of the zero.

While we were unable to investigate the cause fully, it appears to be due to the fact that the diode cathode, while disconnected from chassis, is still emitting and presumably produces a small potential on the diode plate.

MODIFICATION

By re-arranging the circuit slightly so that the plate of the diode was disconnected, this trouble was completely eliminated. The portion of the circuit concerned is reproduced and the changes required are clearly shown.

The valve probe is built into a commercial probe housing, and the one we used was supplied by "Jabel," though any other unit of similar size could be used. In the light of experience since we made the original probes, we decided to try a slightly different—and, we felt—simpler method of construction.

As can be seen from the diagram, the valve socket is supported on an insulating pillar, the other end of which screws onto the rear end of the probe tip. The few components involved are then spaced more or less evenly around it.

The insulating pillar is a standard component measuring 1in x ¼in and tapped 1/8in Whit. at each end. Because of the manner in which it is used its insulating properties are not particularly critical.

The valve socket may be a ceramic or good quality mica filled type, and any metal work fitted to it should be stripped off. To facilitate mounting it on the pillar a 1/8in screw needs to be fitted to the central shield, and this is fairly simple.

FITTING THE SCREW

An ordinary round head screw is modified by turning down the head until it is a neat fit inside the shield. This may be done with nothing more than a small power drill and a file, the only precaution being to see that the screw is initially long enough to allow for any thread which may be damaged in the drill jaws and which will have to be cut off.

A nut soldered to the end of the socket shield will assist in centering the screw and in strengthening the assembly generally. The head of the screw should be tinned before placing inside the shield. Heat applied to the outside of the shield and solder from one end will complete the job.

The .02 mfd capacitor is made from two .01 tubular ceramics connected in parallel, while a third similar unit provides the by-pass on the DC line to the instrument. An insulated anchor point to terminate this capacitor, the calibrating resistor, and the DC lead is provided by making a loop of 20 gauge (approx.) tinned copper wire around the base of the valve socket.

The calibrating resistor will have to be selected experimentally, but should be something more than 4M. We suggest that this value (4M) be made from high stability type resistors and the remaining small valve from a standard type. Half watt types will be perfectly satisfactory.

A three wire cable is required for this probe and this can be made from three lengths of hook-up wire and a length of plastic tubing. About 3ft of each is required. Tubing diameter should be either 4 or 5mm and, if the former is used, one of the leads should be of light gauge hook-up wire, such as 5/.0076. This should be used for the DC lead.

Some form of anti-strain device should be fitted to the cable where it leaves the probe, and this may be a few turns of good quality plastic insulation tape. This same material may also be used if it should appear that any components are in danger of shorting to the probe housing, remembering that the natural insulation of many components is not good.

Finally, means must be found to earth the metal body of the probe. About the easiest way to do this is by means of a lug made from shim brass and which may be wedged between the tip moulding and the metal case. It should be drilled with a clearance hole to permit the assembly screw (a self-tapping type) to pass through it. In this way it will be held in firm contact with the metal housing.

GERMANIUM PROBE

A much smaller probe housing is required for the germanium diode probe and, as for the Senior VTVM, we used a commercial unit made by University Graham Instruments. However, a home-made housing, or any similar commercial unit, could also be used.

Since this housing is now supplied with a small perspex panel on which most of the components may be mounted, we followed this form of construction.

The most important requirement with this probe is to cut down the input capacitance to an absolute minimum. One step is to remove portion of the

(Continued on Page 59)

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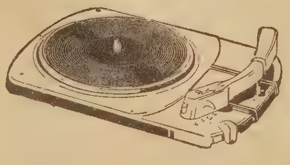

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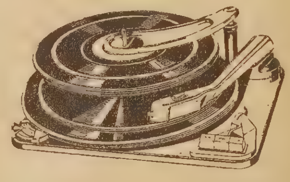

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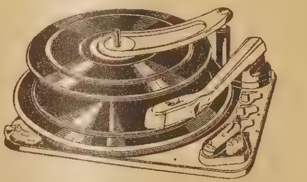

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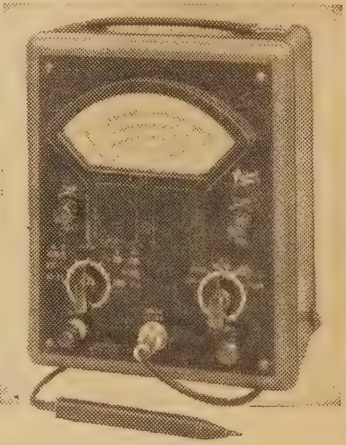

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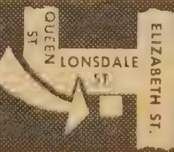

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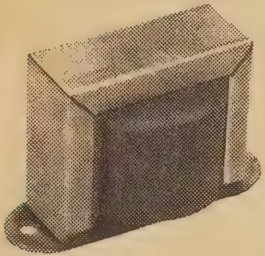

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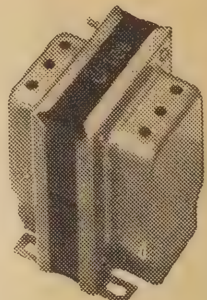

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PROBES FOR YOUR VTV-METER

(Continued from page 55)

threaded section of the probe tip, leaving about ¼in only, which is still adequate to hold it in the moulding.

The 470 pf coupling capacitor is a ceramic bead type and is fitted into a ¼in diameter hole drilled in the moulding alongside the probe tip. A small hole at the bottom of this allows the pigtail from the capacitor to pass through to the probe tip, to which it is to be soldered.

This soldering operation requires a little care in order to avoid damage to the plastic moulding. The correct spot on the tip should be noted, the tip removed from the moulding and this spot tinned. The pigtail also should be tinned, the tip replaced in the moulding and the pigtail wrapped around it once or twice. Finally, the quick application of a very hot iron, such as a Scope, will enable the two blobs of solder to be melted together without imparting excessive heat to the tip.

The perspex panel is ready drilled as it is received and we did not not find it necessary to add any holes. We fitted a small tubular rivet to each hole to serve as a terminal, but small nuts, bolts and solder lugs also could be used.

The general disposition of the components will be clear from the drawing, but a few additional points are worth noting. The perspex panel is a neat sliding fit inside the probe housing and will thus keep all components clear of the latter, provided they are correctly mounted.

Since this panel is not rigidly supported, it must be protected from any form of strain or twist via the cable. Strain may be prevented by simply binding the cable at the appropriate point with light gauge tinned copper wire, but this provides no protection against twist.

To provide this, we drilled and tapped an 8BA hole into the inner face of the metal plug at the rear of the housing and fitted it with an 8BA RH screw. A loop of wire from the binding is then taken under this screw and the latter tightened on it. It is important to leave a loop of cable in the housing as shown in the diagram, to facilitate assembly.

Care should be exercised when soldering the germanium diode into circuit, due to the possibility of damaging this device by excessive heat. Hold each pigtail with a pair of long-nose pliers while soldering and until the joint has cooled.

Since two conductors only are required for this probe, PT9M co-axial cable is a good choice, as with the high voltage probe. If a short length of 4 mm. plastic is pushed over it before the 4-pin plug is fitted, it may be pushed into the back of the plug to serve as a stiffener to minimise bending at this point.

The probe housing is earthed internally in the same manner as the valve probe, but it is also desirable to fit an external earth lead. This is mainly for use at the higher radio frequencies, where a lengthy return circuit via the earth terminal of the instrument could introduce serious errors. A similar lead also may be required with the valve probe in some cases.

A solder lug is fitted to the outside of the probe, directly outside the shim brass lug, and to this is connected a few inches of lead terminating in an alligator clip. Even this may be too long in some circumstances, and it may be necessary to fit a very short lead in special cases.

This should cover most of the constructional and operational points concerning all three probes, and readers should not have any difficulty duplicating them. Whether you choose to provide all three, or a particular one to suit your own requirements, you will find that the usefulness of the already versatile VTVM increased many times.

A NEW HIGH GAIN TRANSISTOR PORTABLE

(Continued from page 41)

aerial coil along the rod until a position is found where the signal peaks in strength.

Now tune a station or signal around 1,300Kc and adjust the oscillator TRIMMER until it comes in at its calibrated position on the dial. Peak the aerial trimmer for maximum signal strength.

After this initial adjustment, repeat the whole operation more carefully, using weaker signals if necessary to emphasise the effect of each adjustment and pushing the aerial coil along the rod with a piece of insulating material. You will find its position quite critical and adjustments to the position and of the aerial trimmer are more interpendent than with the usual aerial coil. A scrap of adhesive tape will hold it in position.

If the IF transformers have not previously been aligned, they can now be peaked up, preferably using a meter as described earlier. Tune the receiver carefully to a station of weak to intermediate strength, note the meter reading and then carefully adjust each core for maximum sensitivity.

So much then for the alignment.

We have not had opportunity to do much work with the aerial circuit itself, with a view to increasing signal pickup under emergency conditions. In the commercial field, two approaches currently are being investigated.

One is to use a rod of larger than usual diameter and a coil wound with quite heavy wire. Using this technique on a ½-inch diameter rod, it is allegedly possible to obtain a 2:1 improvement in signal pickup over a conventional coil and 3/8-inch rod.

The second step is to provide terminals for an external aerial and earth. These connect to about a 3-turn winding around the end of the rod furthest from the tuned coil. One end of the winding goes to the external aerial terminal, the other to earth and to the chassis of the receiver.

We have not been able to verify the value of such a fitment, as yet, under typical adverse signal conditions, but readers should have no difficulty in trying it for themselves. We shall probably have more to say about it in a later issue, remembering that the remarks will apply to all portables using a loopstick aerial — not just the "Transporta Seven."

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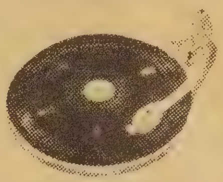

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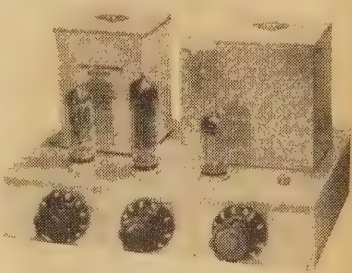

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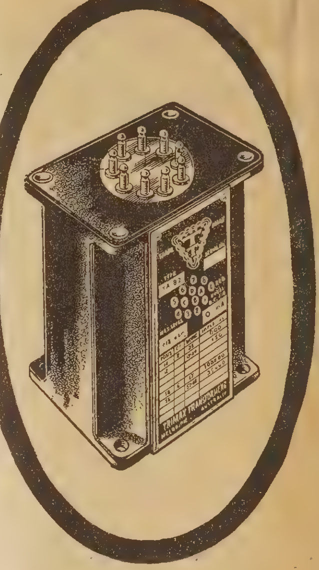

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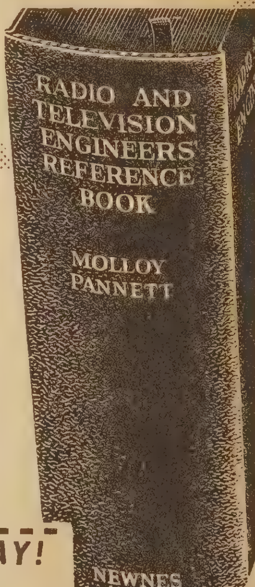

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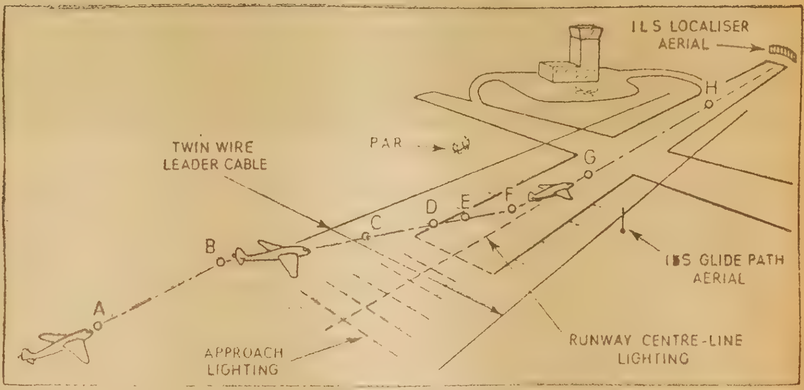
NEW AUTOMATIC BLIND LANDING

BRITISH SYSTEM LOOKS GOOD IN ITS TRIALS

One flying accident in every three occurs during approach and landing, and in thick weather, aircraft have to be diverted. Trials of the Royal Aircraft Establishment's new guidance system show that the remedy may be simple and inexpensive. So far, no system has come into use reliable enough to actually land the aircraft in all weathers on a purely automatic basis. If the problem is solved, one more hazard will have been removed from air travel.



		CONTROL	
	PHASE	AZIMUTH	ELEVATION
A-B	Automatic approach (track)	ILS localiser, compass	Barometric height
B-C	Automatic approach (glide)	ILS localiser	ILS glide path
C-D	Automatic land (leader cable) ..	Leader cable	ILS glide path
D-E	Automatic land (attitude)	Leader cable	Fixed attitude
E-F	Automatic land (flare)	Leader cable	Radio altimeter
F-G	Automatic land (kicking off drift)	Compass	Radio altimeter
G-H	Manual ground run	Leader cable compass	—

TO keep aircraft flying in any weather and to save the pilots, operators and passengers the strain and inconveniences that result from the closure of airfields by bad weather—these are the aims of the Royal Aircraft Establishment's Blind Landing Experimental Unit (BLEU).

Of the various phases of an aircraft's flight, landing is the one most impeded by fog, low cloud, heavy rain and snow. While expensive procedures like Fido (the dispersal of fog by petrol flames) have been used to improve visibility, the most satisfactory remedy is to enable the aircraft to land in spite of bad visibility.

Certain existing radio and radar systems give excellent guidance on the approach and glide paths, but are not sufficient to bring the aircraft right down to the runway.

COMPLETE CONTROL

BLEU has, therefore, perfected, at Bedford, a method for landing an aircraft without the pilot having to touch the controls, let alone see where he is going. The only new ground facilities required are two magnetic leader cables, long electric cables running on either side of the runway, which guide the aircraft so that it is flying down the middle of the runway.

In the aircraft itself there is an automatic pilot, not basically different from existing autopilots. It is, however, adapted to respond to the magnetic leader cables and also to a radio altimeter, the third essential component of the system, which measures the height of the aircraft in the crucial seconds before touchdown.

Other automatic landing systems have, of course, been invented. For example, the U.S. Navy and Bell Aircraft Corporation are developing a system whereby a precision radar on the ground passes positional information to a computer on the ground, whence control signals are radioed to the automatic pilot in the aircraft.

The basic difference is that the "brain" of the system is on the ground, whereas in the BLEU scheme it is in the aircraft. The BLEU experiments aroused great interest at Monte Carlo recently, where the International Air Transport Association was holding its technical conference.

During the past few months, some 2,000 touchdowns have been executed at Bedford using partial or complete automatic control of the aircraft (Varsities and Canberras). There have been no mishaps, although in a very few cases the pilot has resumed control during landing when the monitoring and warning instruments in the cockpit have revealed failure of some kind.

The pilots engaged in the tests are completely confident in the arrangements, and there seems to be no technical reason why automatic landing should not now be developed for regular military and commercial operations.

PRESENT SYSTEMS

At present there is a system known as ILS (Instrument Landing System) working at the major airfields of the world, and BLEU has incorporated this into its system. The localiser (seen at the end of the runway in the accompanying diagram) directs a radio beam down the line of the runway.

The beam is divided into two zones, to the left and right of the central line, in which modulations of different frequencies predominate. On the central line the two signals are of equal strength. Thus the pilot or automatic pilot can line up the aircraft with the runway.

By NIGEL CALDER

To give the aircraft its glide path there is a second transmitter alongside the runway near the touchdown point. It works like the localiser except, of course, that the aerials are turned on end and define a central path slightly inclined to the ground.

Using ILS, the pilot still has to see the runway eventually and complete the touchdown himself. For flying in zero visibility the automatic landing system takes over where I.L.S. leaves off.

AUTOMATIC

It would, of course, be possible to provide the pilot himself with additional information to enable him to perform the touchdown blind. But experience with the ILS shows that automatic control is more accurate and blind landing in a modern aircraft is coming close to the limit of human performance. As it is, the only thing the pilot has to do is lower the undercarriage and monitor the BLEU equipment.

The arrangement of the leader cables on either side of the runway is shown in the diagram. They are cables lying 250 feet from the centre line and extending about a mile in front of the approach end of the runway, so that the aircraft enters between them (point C in the diagram) when it is still at an altitude of about 300 feet. Generators supply alternating currents of different frequencies (600 and 900 cycles per second) to the two cables, and an electronic control ensures that the currents are stable and of equal strength.

The magnetic effects of the currents in the two cables are picked up by a rotating loop aerial mounted outside the

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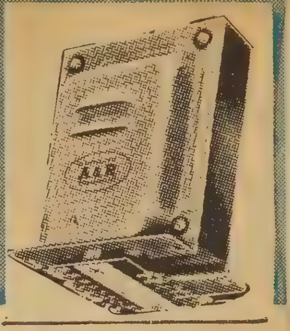

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			2525-15	High or Low Load, Secondary, 3.7 or 15 ohms.	Silicon Core
			2540-8	Ultra Linear, Secondary, 2 or 8 ohms.	Silicon Core
			2540-15	Ultra Linear, Secondary, 3.7 or 15 ohms.	Silicon Core
			4000-8	Ultra Linear, Secondary, 2 or 8 ohms.	Alphasil Core*
			4000-15	Ultra Linear, Secondary, 3.7 or 15 ohms.	Alphasil Core*
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931-8	20	4500 ohms P.P.	2 or 8 ohms.	10-60,000 C.P.S.	EL37, KT66, 6L6, etc. 19% Screen Taps
921-15	20	6600 ohms P.P.	3.7 or 15 ohms.	10-60,000 C.P.S.	807, KT66, etc. 19% Screen Taps
921-8	20	6600 ohms P.P.	2 or 8 ohms.	10-60,000 C.P.S.	807, KT66, etc. 19% Screen Taps
916-15	12	8500 ohms P.P.	3.7 or 15 ohms.	10-50,000 C.P.S.	6BW6, 6V6, KT61, etc. 19% Screen Taps
916-8	12	8500 ohms P.P.	2 or 8 ohms.	10-50,000 C.P.S.	6BW6, 6V6, KT61, etc. 19% Screen Taps
949	12	8000 ohms P.P.	2, 8, 12.5 ohms. 15 ohms.	10-50,000 C.P.S.	6V6, 6BW6, KT61, EL84, 19% Screen Taps

SPECIAL HI-FIDELITY

Type	Watts	Primary	Secondary	RESPONSE	VALVES
870	6	10,000 ohms P.P.	2 or 8 ohms for	+- 1db 20-40,000 c.p.s.	6V6G's, 6BM8's, etc.
871	12	10,000 ohms P.P.	Rola 12 ox.	+- 1db 20-40,000 c.p.s.	6L6G's, 807's, KT66's, Triodes
872	12	10,000 ohms P.P.	2 or 8 ohms. 3.7 or 15 ohms.	+- 1db 20-40,000 c.p.s.	6L6G's, 807's, KT66's, Triodes

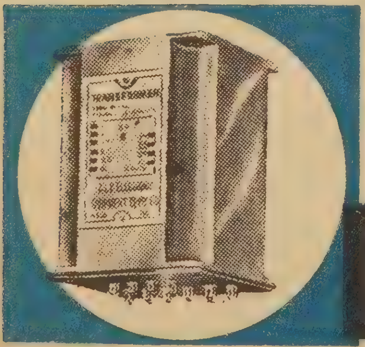
HI-FIDELITY

Type	Watts	Primary	Secondary	Response	VALVES
763	15	5000 3000 ohms P.P.	15, 12.5, 8, 3.7 and 2 ohms.	+- 1db 30-15,000 cps.	2A3's, 6A3's, etc.
920	15	5000 3000 ohms P.P.	500, 250, 166, 125 and 100 ohms.	+- 1db 30-15,000 cps.	2A3's, 6A3's, etc.
897	15	10,000 8000 ohms P.P.	500, 250, 166, 125 and 100 ohms.	+- 1db 30-15,000 cps.	6V6G's, 6BW6's, 6M5's, etc.
896	15	10,000 8000 ohms P.P.	15, 12.5, 8, 3.7 and 2 ohms.	+- 1db 30-15,000 cps.	6V6G's, 6BW6's, 6M5's, etc.

MEDIUM FIDELITY

Type	Watts	Primary	Secondary
809	15	500 ohms	15, 12, 8, 3.7, 2 ohms
914	15	5000 3000 P.P.	500, 250, 166, 125 and 106
915	15	5000 3000 P.P.	15, 12.5, 8, 3.7 and 2
917	25	10 000 8000 P.P.	500, 250, 166, 125 and 100
918	15	10,000 8000 P.P.	15, 12.5, 8, 3.7 and 2
922	15	8000 P.P.	500, 250, 166, 125 and 100

Type	Watts	Primary	Secondary
891	35	6600 P.P.	500, 250, 166, 125 100, 83 ohms
892	55	3200 P.P.	500, 250, 166, 125, 83 62 and 50
928	5	7000 5000 S.E.	12.5, 8, 3.7 and 2
929	10	4000 2500 S.E.	15, 12.5, 8, 3.7 and 2
930	10	4000 2500 S.E.	500, 250, 125
932	7	10,000 P.P.	15, 12.5, 8, 3.7 and 2



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metallic skin of the aircraft; a very simple receiver discriminates between the two frequencies and compares the magnetic strengths. Above the centre line they are equal, and departures to right or left are measured by the difference between them.

This information from the leader cables is used to control the aircraft from point C (in the diagram) to point F. Here a correction is necessary: the leader cables enable the aircraft to move straight down the runway, but if there is any crosswind its nose will be pointing slightly upwind. At an altitude of 20 feet the compass is switched in, so that the autopilot can turn the aircraft to point along the known direction of the runway at the moment of touchdown. Finally, the pilot takes charge again and uses the magnetic leaders to taxi down the runway.

ALTIMETER LIMITATIONS

Turning now to the automatic control of the rate of descent to touchdown, it is plain enough that the barometer traditionally used for measuring altitude cannot be adequate for easing an aircraft down at a controlled rate within inches of the runway. The radio altimeter, which has been specially developed, works at a frequency of 4,200 megacycles per second (seven centimetre wavelength). The radio beam is directed at the ground and its frequency is continuously altered, so that by comparing the frequencies of the returning wave and the outgoing wave the echo time and hence the height is determined.

The instrument can measure accurately down to two feet. It is, however, not suitable for accurate guidance over the uneven terrain and built-up areas which the aircraft encounters before it crosses the airfield boundary. There is therefore a gap between the altitudes of about 150 feet (where the I.L.S. guide path is no longer used) and about 60 feet (where the radio altimeter takes over).

In the interval the autopilot "freewheels," holding the aircraft in the general attitude of descent adopted on the I.L.S. glide path. Improvements in I.L.S. at altitudes below 150 feet may very well close this gap.

DESCENT RATE

In any case, at 60 feet the automatic landing phase by radio altimeter begins. At this moment the aircraft is losing height fairly rapidly at about 10 feet a second; by the time its wheels touch the runway it must, to avoid jarring or bouncing, have "flared out" so that it is travelling almost horizontally. This is done by arranging that the aircraft's nose is lifted by a pre-arranged mathematical law (exponentially) as the height diminishes. By this means B L E U regularly achieves impacts at only about 2 feet per second—equivalent to a free fall of ¾ inch.

Automatic control of forward speed is, in a sense, a refinement of the system, but B L E U is now making full use of it because of its value in bringing aircraft to the best touch down point. It is especially important for jets, which need all the runway they can get.

The pilot pre-selects his approach speed; thereafter the throttles are automatically adjusted to maintain this speed until immediately before touchdown, when they are closed to the safe idling condition.

I have said nothing about the servo-mechanism and electronic "black boxes" which perform the various control functions. The techniques are commonplace nowadays: the aim is to design electromechanical circuits which are simple, easy to maintain, light and compact. The total airborne weight of the B L E U equipment (excluding the autopilot) is at present 100 pounds. Above all, the equipment must be even more reliable than that used in less critical phases of the aircraft's flight.

B L E U has naturally given a great deal of thought to this matter of reliability. If the automatic landing system is to be introduced it must give rise to far fewer accidents than all other causes taken together, which, in civil flying now amount to about two accidents per million flying hours.

If the automatic landing system can be developed with a failure rate of 1 per 10 million flying hours, it will reduce the present accident rate, because 30 per cent of aircraft accidents occur during approach and landing.

To achieve such reliability at least two courses are open. Either the entire system can be duplicated, or else there can be provided an alternative blind landing system—one, for example, which uses the pilot instead of the auto-pilot and gives him a television-like picture of the aircraft relative to the runway.

CABLE LIMITATIONS

The leader cables, extending as they do a mile in front of the runway, may prove an embarrassment where new land would have to be purchased and where power and telephone cables are already running. The leader cables are not sacrosanct, and it would obviously be better altogether if the I L S localising beam could be improved for use between 150 feet and zero altitude. It is chiefly a matter of narrowing the I L S beam, making sure that it is very accurately aligned at the end of the runway (and not offset as it sometimes is at present), and ironing out distortions in the beam due to objects on the ground. Alternatively, a wholly new radio localiser might be devised, working at a shorter wavelength.

Without doubt, many months will pass before international agreement is reached on the specifications for automatic blind landing equipment. Nevertheless, the scientists and engineers at Bedford believe that their flight tests of experimental equipment show that the system need no be particularly complex, and that the cost should certainly be small compared with the benefits of being able to land aircraft safely in any weather.

Plastic Gas Mains

THE major gas undertakings in England are considering the introduction of rigid polyvinyl chloride piping. An experimental 12in coal gas main has been in use in the South Wales area for 12 months without any signs of deterioration. One of the strongest incentives for a switch to this material is its resistance to corrosion from which buried iron pipe lines tend to suffer, even when heavily protected.

In parts of Holland where the soil is corrosive, plastic water pipes have been installed for some time. Some difficulty has been encountered with trial gas mains of this type in Britain due to certain, as yet unidentified, components in the town gas produced in a few areas,

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SF8	13	8	8½	**1**	**11**	**6**
SF10	18	10	10	**2**	**6**	**0**
SF79A	9¼	7¼	7¼	**1**	**5**	**0**
SF71A	11	7¼	7¼	**1**	**10**	**0**
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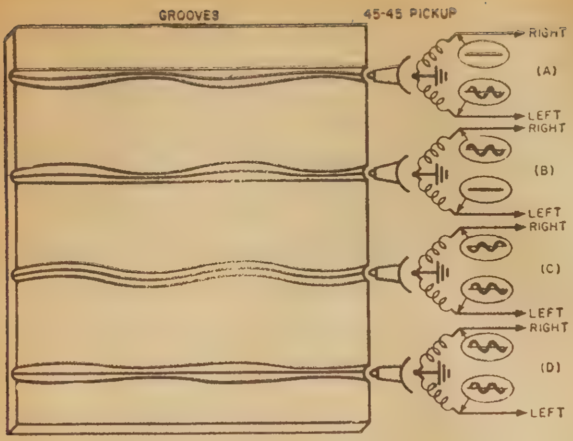


Fig. 1. The relationship between various types of grooves on a 45-45 disc and the outputs from the stereo cartridge discussed in the article. Although coils are shown, ceramic elements would produce the same results. (A) and (B) show sound in one channel only, while both channels have equal signals in (C) and (D). In (C) the cut is completely lateral, in (D) it is vertical.

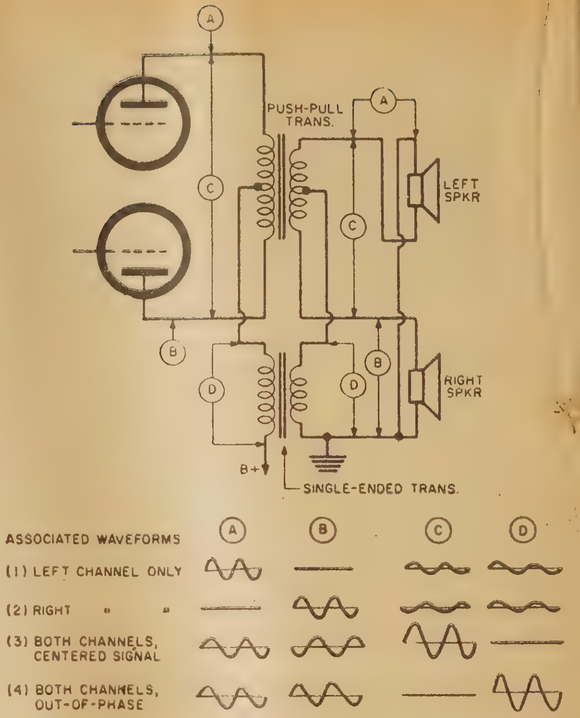


Fig. 2. The double-matrixing transformers operate push-pull and "push-push," or single-ended, to produce these waveforms.

Single Amplifier For Both Stereo Channels

The principle described in this article, printed by arrangement with Radio and Television News, is similar to the "simplex" system freely used in telephone line engineering, and looks promising, particularly in designs where minimum cost is important. It could well find an application in commercial practice.

By Norman CROWHURST

IF stereo can be recorded in a single groove, why cannot it be amplified by a single amplifier? As with so many questions, this one has two possible answers; It can't be done; and the people who do it! In this case the latter are CBS Laboratories, as reported in a paper before the Audio Engineering Society, jointly authored by B. B. Bauer, W. S. Bachman, J. Hollywood and G. Maerkle.

HOW DOES IT WORK?

The question, "How does it work?", which this article aims to answer, can likewise be asked with different attitudes: The man who said it can't be done has objections, and doesn't think it can work properly; while the person who is unprejudiced just wants to know, in simple terms, the principles involved, as well as, "Does it do a job as good as two separate amplifiers, of the same, or lower cost, or with the same total output?"

In an ordinary push-pull amplifier, all the tubes and other components of the push-pull part are in duplicate, and handle audio exactly the same, except that one "pushes" when the other "pulls." For good push-pull operation, both "halves" of the amplifier carry identical waveforms, except that one swings up when the other swings down. Usually great care is exercised to ensure the two halves are balanced so the waveforms really are identical.

But actually a push-pull amplifier is two separate amplifiers, the only tie together being at the input, or phase inverter, and the output, a push-pull transformer. Failure to maintain the ideal balance would not cause any trouble until the two are re-combined at the output. So what is to stop each side of the "push-pull" stage being used for one channel of stereo, instead of going to all that trouble to get exact identity for just one output? And, when you look at it, the principle is quite simple (although one can always say that when someone else has already done it!). In fact, it's as simple as making each half carry the modulation from one side of the record groove in a 45-45 record (Fig. 1).

By now it is well known that, when the two channels work together, as they do for a centre-located sound, the groove moves from side to side without any change in depth (Fig 1C). When only one channel carries program, due to a sound originating from one extreme side, only one wall of the groove is modulated (Fig. 1A or 1B). And when the two work in opposition, the groove goes directly up and down (Fig. 1D).

NOW AT LOW FREQUENCIES

This last condition does not normally happen at lower frequencies, because it would represent a sound "off-stage." But it can and does happen at higher frequencies, because the time difference can then amount to several wavelengths.

From Fig. 1 it will be seen that the centre-located sound gives the normal push-pull wave-form combination, while the out-of-phase condition gives "push-

Fig. 3

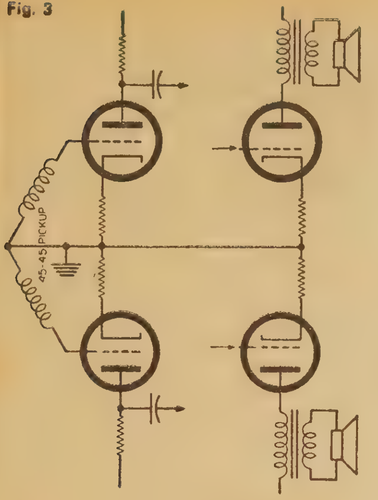


Fig. 3. With single-ended output transformers, a full-length, push-pull amplifier could be used as two separate single-ended amplifiers as described in the text.

Fig. 4

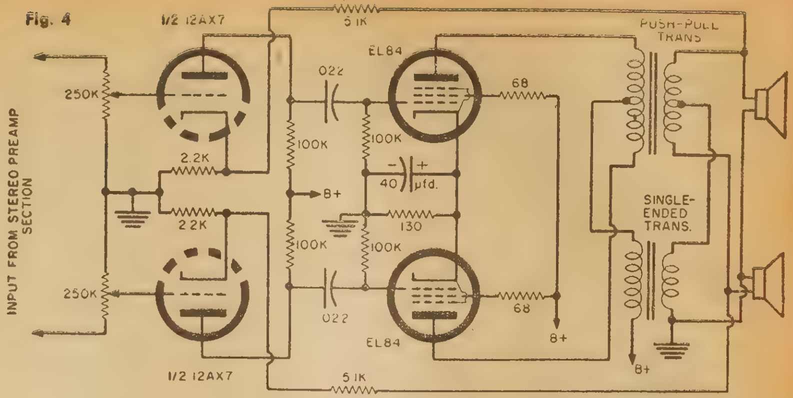


Fig. 4. Schematic diagram of driver and output stages, showing use of feedback.

Fig. 6. Class B operation is a condition not completely realisable in practice: it depends on "curves" with straight lines and sudden corners (A); practical tubes have bends (B).

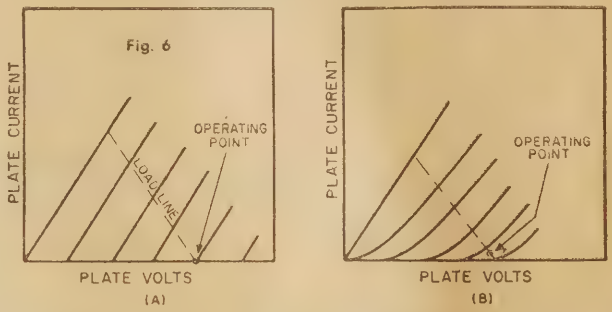


Fig. 5

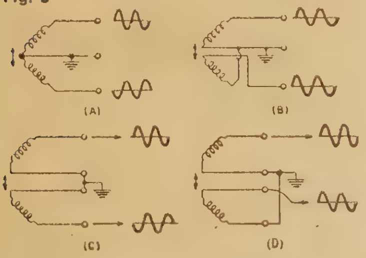


Fig. 5. The two possible ways a 3-terminal cartridge can be connected internally (A) for CBS push-pull system and (B) for "regular" separate system. A 4-terminal cartridge can be connected (C) for CBS system and (D) for "regular" stereo system.

push." Stereo program would be mono if it only contained the push-pull combination, but, on the other hand, very little of it reaches the completely push-push condition of simple up-and-down. Most of it lies somewhere between these extremes.

(Most common stereo cartridges are phased in such a way that lateral motion produces in-phase signals. By simply reversing the connections to one of the pickup elements, the phase conditions shown in the figure are obtained. With 4-terminal cartridges this is simply a matter of transposing 2 leads; with 3-terminal cartridges the manufacturer must provide the required phasing. See Ques. 2.—Editor.)

DOUBLE MATRIX OUTPUT

If one pick-up output were fed into each side of the so-called push-pull stage, and each side had a separate output transformer feeding its own loudspeaker, we should have a couple of separate amplifiers working from a common power supply, of the quality normally expected using single-ended output stages (Fig. 3). The kernel of the new development is the double matrixing (mixing) output circuit that effects an economy in output transformer requirements, and at the same time enables the normal advantage of push-pull output to be obtained.

Instead of using one output transformer for each channel—left and right—separate transformers handle virtually the "lateral," or push-pull and "vertical," or push push components (Fig. 2). Remember, the out-of-phase condition never normally happens in stereo program at low frequencies, and only stands a random chance of happening at higher frequencies.

So the transformer that carries the two plate currents in parallel does not need a good bass response. Thus the normal objection to a single-ended output—loss of bass—is avoided in having the transformer acting single-ended. The CBS paper also claims an advantage in down grading bass response to the "vertical"—a built-in vertical rumble rejection, that certainly can often be helpful.

EDITOR'S NOTE: *The circuit discussed in this article aroused considerable interest when it was introduced in a paper presented by CBS engineers before the Audio Engineering Society. Here we evaluate the system, and answer some of the questions that have been asked about it.*

The importance of the circuit lies in the fact that two output tubes and one full-power output transformer are able to handle both stereo channels. There are some limitations to the flexibility of the input and output circuits. but from where we sit, it appears that the circuit will find widespread use.

As we go to press, the Heath Co., under licence by CBS Laboratories, is investigating an inexpensive stereo system utilizing an improved and more sophisticated version of the principles described herein.

The other transformer acts strictly push-pull, and thus is able to have all the qualities of a push-pull output transformer. Now we begin to see where the saving comes in. Only one high quality push-pull output transformer is needed; the other can be smaller and much cheaper. And we need only one push-pull output stage, as regards all the other components, through which to feed stereo program material.

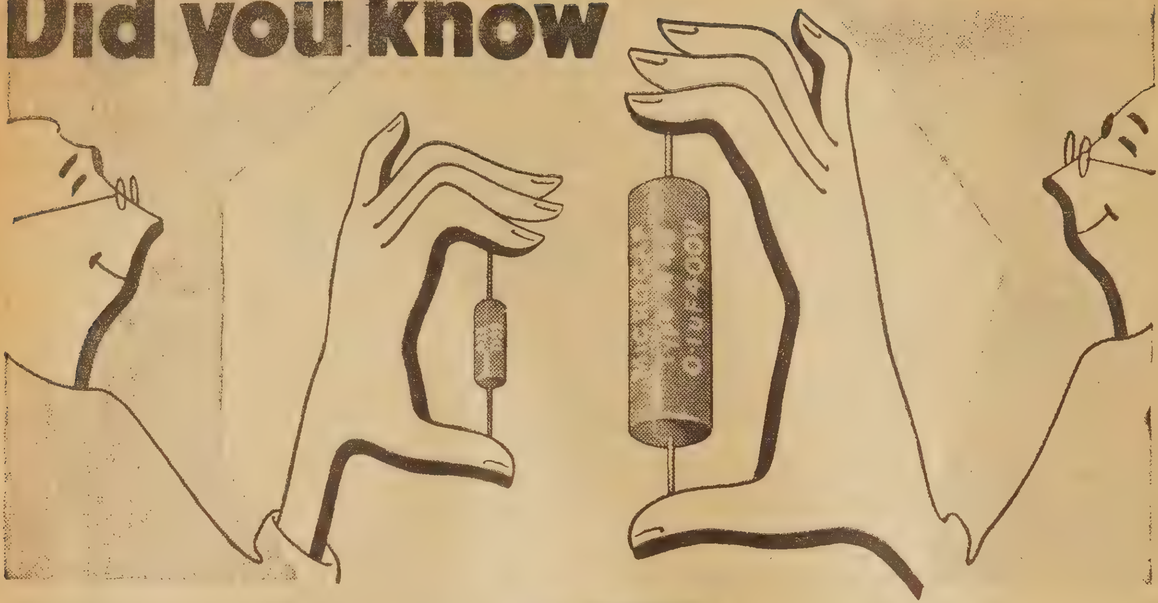
Feedback is taken from the resultant output to the voice coils, back to the cathodes of the driver stage (Fig. 4). This can reduce distortion in either channel (left or right), correct frequency response, and reduce any error in the double-matrixing action of the output transformers.

QUESTIONS AND ANSWERS

That about tells the story as far as the principle is concerned. But a new idea like this will start (in fact it has started) some questions, with the idea, "Does it really buy all this?" So let's take some of these questions, as a way of exploring the potentialities of this kind of amplifier.

1. You said the push-pull transformer has all the advantages of a normal push-pull output transformer. I can see that the static, or quiescent plate currents will balance and thus maintain its inductance and low frequency response; but isn't part of the function of a normal

Did you know



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output transformer to cancel even order distortion from the amplifier? How can this happen when the amplifiers are handling different channels?

This objection would be true for separate, single-ended output transformers (Fig. 3). But with this arrangement, the push-pull transformer only handles that part of the composite program content that is strictly push-pull. The "single-ended" component is handled by the smaller transformer. There is, in almost any stereo material, a dominance of high amplitude lower frequency component almost in phase. Any distortion of these components in the amplifier is cancelled by the push-pull transformer in the same way as a regular push-pull output.

Then, in the final amplifier circuit, overall feedback, from the individual speaker connections, goes back into the amplifier to linearise each channel as an entity, regardless of its division into mono and stereo (or push-pull and push-push) components.

REDUCED DISTORTION

The major form of distortion reduced by the normal push-pull output transformer is this lower frequency component. The push-pull transformer here does it, too, both as regards harmonic and I.M. components. Distortion higher up, which gets more complicated, anyway, is taken care of by the feedback, as it also is in any normal amplifier.

2.—Will not the loudspeakers, connected as at Fig. 4, reproduce the stereo out-of-phase?

This is a matter of phasing, at both input and output. Most three-terminal pickups are phased so that lateral motion of the stylus gives two outputs that are positive at the same time (Fig. 5). In this system the pickup has to be connected so, for lateral motion, one output is positive at the instant the other is negative.

In the gramophones using this amplifier the pickup is phased correctly for the purpose. Using the amplifier with other pickups is no problem when there are four terminals, so the user can phase his pickup to suit.

If you've become used to thinking the way most systems are connected is standard, then this system will seem non-standard to you in this respect. But it really depends which you start off with as the standard. From the viewpoint of the cutter, or pickup, basic symmetry would require the up-and-down component to be the in-phase, or push-push, element, which agrees with this system and makes the more generally accepted connection "non-standard."

CONNECTIONS

As far as functioning is concerned, all that matters is that it be connected the right way, which only has to be done once, when setting up the system.

At the loudspeaker end, if identical units are used, the opposite end of the voice coil(s) have to be connected to the ground bus on the left and right systems. But, again, once the system has been phased everything works correctly. The thing is purely relative.

3.—One reason, or advantage of push-pull operation, is improved efficiency of the output stage. This is achieved by working at, or nearer, class B operation. In view of the fact that this system uses a push-push component, can it utilise this advantage properly?

Class B is a theoretical condition, postulated on plate characteristics that make an abrupt, or discrete transition from the straight lines representing constant AC resistance, to cut-off condition, representing infinite resistance (Fig. 6). No tubes ever made operate just this way.

But working well "around the bend" as a single-ended tube can result in excessive curvature. And the parallel or vertical component does pass through this amplifier as a "single-ended" operation. Let's give a little thought to what can happen in a single-ended amplifier of this type with feedback.

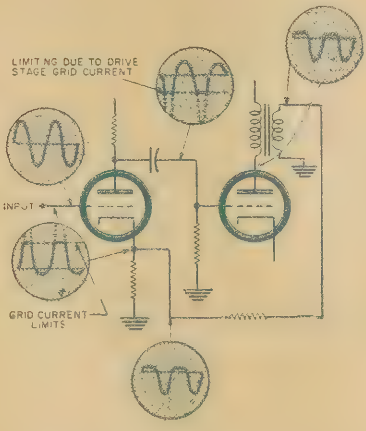

Fig. 7. Waveforms in single-ended amplifier with feedback when the output tube is driven beyond cut-off. See text.

Assume it is biased to a point well in the curvature, and that a signal comes through that drives it "around the bend" —in fact well into cut-off. Feedback tries to offset the waveform inside the amplifier that is distorted in the opposite way (Fig. 7). But it can only work on parts of the waveform that get through. For the part beyond cut-off there is no feedback.

FEEDBACK TIME CONSTANT

So the internal waveform becomes exaggeratedly asymmetrical the opposite way. As has been proved many times, such an asymmetrical component in a waveform is equivalent to a change in DC bias; in this case it will work progressively, like a "pump", until the feedback can "get to work" on the whole waveform.

In effect, the feedback will use the time constant of the coupling between drive and output stage to alter the bias just enough to allow the stage to handle the signal completely, so it can work on linearising all of it.

But, if this were the only means, and the time constant is made long enough to represent a good bass response (which is needed for the push-pull mode), quite a bit of distortion can occur before the bias gets readjusted. Fortunately, however, with the circuit shown in Fig. 4, another effect can take charge meanwhile.

When the large signal first "strikes," its first positive excursion at the grid of the drive stage (Fig. 7), it won't be offset by corresponding feedback at the cathode, because the output tubes will run well into cut-off.

Consequently, from the point where the output tubes cut off, the grid voltage here will rise sharply positive, and due to grid current, will temporarily bias this stage back by a corresponding amount. With proper choice of time constants, this will pass a similar temporary bias to the output stage—positive, so the output stage can immediately handle the whole signal.

AUTOMATIC CORRECTION

So, after the first quarter wave of a big vertical component (unless it runs the output tubes into the positive grid region now, in which case, the signal is just too much anyway), the output tubes find the right bias for the signal coming through by means of the feedback action. From then on the feedback maintains a correct balance in bias adjustment.

Doesn't having the tubes handle a "double" signal—push-push as well as push-pull—limit the maximum power of the amplifier as compared with normal push-pull operation, in spite of any self-adjusting action?

To tackle this question I went to the Mullard "Technical Handbook of Receiving Valves" to see what I could expect of a couple of EL84s. In class AB, self-biased push-pull, with 300 volts on the plates, they give 17 watts. A figure is not given for the same operating condition in parallel, but an inspired guess from figures given for a single tube operating at 250 volts suggests they would give around 13 watts under this condition.

Working in this circuit, if a pure signal is fed in, in-phase in both channels, so as to work the tubes in push-pull, they will give their rated 17 watts into the rated resistance load. This will be shared between the left and right channel, after an appropriate loss in the output transformers.

Similarly, if one channel is reversed in phase, to be equivalent to a vertical cut, the tubes should deliver 13 watts into the same kind of load. So, when someone asks whether this mode of operation will limit the power, do they want to get 17 plus 13 watts equals 30 watts, for the same money they can normally get 17 watts?

Actually, under the hypothetical conditions represented in such tests, the amplifier should always be able to deliver somewhere between 13 and 17 watts, according to phase angle between channels.

PHASE ANGLES

But actual stereo program does not possess a single frequency with known or constant phase difference between channels. Different components will have different phase angles, at quite random distribution. But this is nothing new. The same invalidation of wattage ratings occurs with normal amplifiers.

An amplifier is never called upon, in musical program, to deliver 17 watts pure sine tone into a resistance load. It's called on to deliver a multiplicity of complex tones into a loudspeaker. **If it had a resistance load,** the maximum peak power of the complex wave would be just twice the average power of the theoretical sine-wave output. That's

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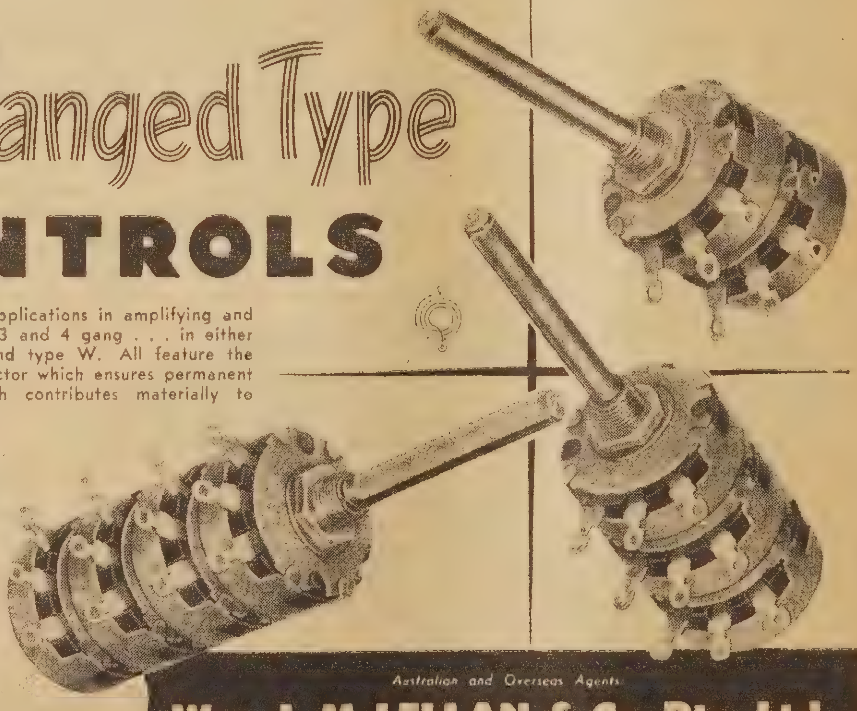

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about as nearly as we can relate the measured results to practical performance.

With the combined stereo amplifier, if both loads were pure resistances, the maximum peak power delivered to the two channels combined will be somewhere between 26 watts minimum (2 x 13) and 34 watts maximum (2 x 17). Different proportions of different component frequencies may get delivered to each channel, but this is the maximum peak power of the composite, still assuming that inaudible resistance load.

5. What about crosstalk in a combined amplifier like this?

The original claim is that the separation between the channels "on the average is better than 25 db." There is something about the crosstalk question that needs clarifying here. How much separation do you actually require anyway?

CROSSTALK

The answer to this question requires qualification. It depends on what the crosstalk is. If it is pure crosstalk—left program breaking through to right, or vice versa, 10 to 12 db separation is quite adequate. But if it should happen to be distortion components of left program showing up in right, then 30 or 40 db is not good. So, when you measure crosstalk, do you have simple crosstalk, or instead do you have cross-intermodulation?

Pickups, as well as combined amplifiers, will need more careful scrutiny from this viewpoint. There is no reason why a combined amplifier should not have a separation of better than 25 db that is pure crosstalk, due to slight imbalances and tolerances on transformer ratios, etc. Actually, a complicated mechanical structure with non-linear compliances controlling its motion is much more likely to produce the cross-inter-modulation variety than a combined amplifier, in which transfer is more or less like simple break-through from one channel being handled by the amplifier to the other.

But now we are getting onto much bigger questions that open up avenues for further work before we can say we know all about these stereo problems. Meanwhile, the single stereo amplifier definitely works, and provides certain economies that make it quite worth while.

We can expect to see shortly announcements of commercially available equipment using these principles.

Stirring the Turbine

A COMPRESSED-AIR starter for jet engines, already ordered by one airline and on offer to all, employs a rotary screw compressor, in which two intermeshing screws turn in opposite directions to drive a stream of air under pressure through a hose to start a gas turbine moving. It is driven by a petrol or diesel engine.

The stream of compressed air acts on the turbine wheel, which turns the jet engine's own compressor and so starts the cycle of operations. The same stream, already warmed in the process of compression, can also be used to remove ice from wings and control surfaces. The apparatus is also capable of heating cabin and cockpit.

A variety of subsidiary duties, like testing an airliner's cabin pressure system, can be undertaken by this mobile blower.

WILL METEORITES WRECK FIRST SPACE SHIP?

(Continued from Page 19)

comets pass in very close proximity to the earth.

According to Kenneth Heuer it has been computed that the nucleus of a comet which comes within the earth's distance from the sun stands about one chance in 400 million of hitting the earth. He goes on to say that as about five comets come within the earth's distance from the sun each year, a comet's nucleus should strike the earth, on an average, once in about 80 million years. Therefore, during the earth's two thousand million years of existence it must have suffered about 25 collisions. And we are still here.

The outer parts of the head or Coma of a comet would frequently come in contact with the earth and, because of the enormous size of the tail, the earth has many times passed through this appendage without people being poisoned with poison gases.

The closest observed approach of a comet to the earth was in 1770 when Lexell's comet came within a distance of one and a half million miles. This caused the comet's revolutionary period to be altered by two and a half days because of the earth's gravitational effect.

The American astronomer Russell calculated that if the comet had a mass one-thirteenth-thousandth that of the earth our year would have been one second longer. If the mass of the comet was the same as the earth's our year would become two hours and 40 minutes longer than normal.

It would appear that if the head of a comet was to come close enough to the earth to be attracted by the gravitational field of the latter, nothing more than a display of meteors would result.

If, however, the nucleus struck, there could be severe devastation. It is believed that the huge crater in Arizona was caused by the collision with a comet about 50 thousand years ago.

This crater is 4,000 feet in diameter with walls rising above the ground to a height of 150 feet. The floor of the crater is 600 feet below the top of the walls. This vast crater would accommodate over two million people seated around the walls like a playing field and the floor would accommodate several large playing areas.

Some 300 millions of tons of solid rock were shattered by the collision, much of which fell back into the crater. The actual depth of the crater is believed to be 800 feet. The debris has filled the actual crater with 200 feet of shattered rock.

Large masses of tiny crystals of nickel iron are present in the ground around the crater and there are large numbers of different kinds of meteorites. As the comet's nucleus is believed to consist of such a conglomeration of junk it has been concluded that the destruction was caused by collision with a comet. It would not be surprising if comets now contained rocket casings, space monkeys, dogs and the like.

SELECTED COMPONENTS FOR THE TRANSPORTA 7

by JABEL
- Cabinets—Polished Rosewood, or two-tone Leatherette.
- Printed wiring board, RF-T7.
- Calibrated dial (2½") and matching volume control knob.
- 50 pf trimming condensers.
- T7 Coil kit, comprising:—Loop stick, aerial coil, oscillator coil, and 1st, 2nd and 3rd I.F. Transformers.
- Chassis frame with aerial rod brackets.

by BRAMCO
- New driver TD3/2X and Speaker TS375X transformers have low D.C. resistance well within the tolerances specified.

by MORGANITE
- Special low "hop-on" resistance switch pots, specially developed for this project.

by ROBLAN
- 2-gang 415 pf miniature condenser.
- 1" extension shafts.

from
RADIO SUPPLY HOUSES EVERYWHERE

Factory Distributors, WATKIN WYNNE PTY. LIMITED Crows Nest, N.S.W.

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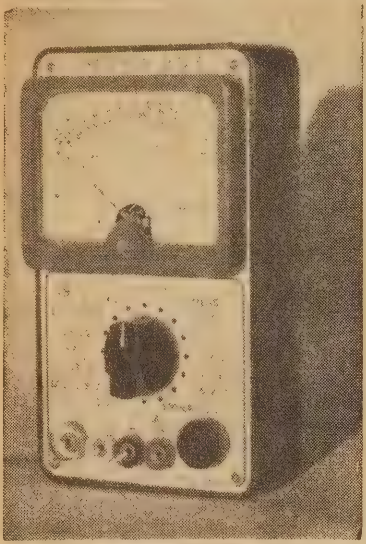

TESTER BOY MULTIMETER

The Tester Boy Multimeter is ideal as a portable instrument for the hobbyist motor mechanic, etc. Dimensions are 6 in high, 2⅜in wide, and 3⅝in deep.

Weight 1lb 13oz.

Ranges as follows:—

Volts AC and DC 2.5, 10, 50, 250, 500, 5000.

Resistance 0-10,000 ohms, 0-100,000 ohms and 0-1 meg. ohms.

Decibels minus 20db to plus 10db. Odb to plus 22db. By referring to a chart up to plus 56db may be measured

The case is black bakelite with a metal panel and 3in meter. Test leads are provided and also a leather carrying case. Sensitivity of meter is 1000 ohms per volt.

Price of this unit is £7/10/-

Erecor Multimeter

Features of this pocket sized Multimeter are:

Size 3 15/16in x 3 9/16in x 1½in.

Meter sensitivity 1.000 ohms per volt. AC and DC Voltage Ranges 0-10, 50, 250, 500 and 1,000 volts. DC Current 0-1, 0-250. Resistance 0-100,000 ohms.

A 4in square jewelled meter is used. This is a very handy and accurate meter.

Price only £5

TE 106 Pencil Tester

This meter is only the size of a fountain pen, clips into the pocket and is ideal for servicemen.

Ranges are as follows.

AC, DC Volts 0-12, 0-300, 0-600. Ohms, 0-50,000.

Supplied complete with Test prods. **Price only £3/10/-.**

SPECIALS

1. **Zero Centre Ammeter,** 3½ inches ammeter. 30-0-30 amps DC. This is a moving coil Meter and worth at least £4/10/-. Our price only 30/- each.
2. **Multi Electrolytic Condensers.** 8 mfd. 525P.V. plus 8 mfd. 525 P.V. plus 25 mfd. 40 P.V. in can 1 3-8 inch diameter x 2 inches long. These are worth 12/6 Our price 4/9.
3. **Ferroxcube Rod Aerials with coil.** Ideal for portables, mantel sets, etc.; equal to 60ft outside aerial. Price only 16/6 each.
4. **Germanium Diodes.** English make, brand new and perfect. Ideal for use as crystal detectors, rectifiers, etc. Price only 3/11
5. **Single Earpieces,** as supplied with Japanese crystal sets, etc.; brand new and boxed. Very small hearing aid size. Price only 12/6
6. **Aluminium Chassis.** Undrilled, available as follows.

5 x 3 x 2	6/9	13 x 7 x 2½	14/-
6 x 5 x 2	7/6	13 x 10 x 2½	17/6
8 x 5 x 2½	10/-	17 x 8 x 3	22/6
10 x 6 x 2½	12/-	17 x 10 x 3	25/6
11 x 8 x 2½	14/-	17 x 12 x 3	26/-

SPECIALS

7. **Twin Rubber Covered Leads.** With phone plug attached. Length of lead 4ft. Price only 2/- each.
8. **Few only** 6-inch Rola Speakers, stripped from partly completed chassis. Large magnet type. Price only 22/6 each.
9. **High Impedance Headphones.** Brand new with phone cord. Price only 22/6 paair.
10. **Crystal Set Coils.** Not for metropolitan area; very selective. Circuit provided only 7/6 each.
11. **Crystal Set Coils, No. 2,** for country; very sensitive. Circuit provided only 8/- each.
12. **Coil Winding Wires.** Wind your own coils for crystal valve and transistor sets. Below are listed popular wires and prices per yard and also ¼lb Reels.

SPECIAL NOTICE
All parcels sent Registered Post unless otherwise stated. Postage or Freight must be included with order.

SPECIALS

B & S	S.W.G.	Enamelled per yard	Enamelled per ¼lb reel
15	17	5d.	
16	18	4d.	
18	19	4d.	7/6
20	21	4d.	8/-
22	23	3d.	8/3
24	25	2d.	8/9
26	27	2d.	9/4
27	29	2d.	
28	30	1d.	10/9
29	31	1d.	
30	33	1d.	11/3
33	37	1d.	14/6

13. **Bakelite Formers** can be supplied cut to the length you require.

Diameter	**Price per inch**
¾ inch	5d.
1 inch	5d.
1¼ inch	6d.
1½ inch	6d.
2 inch	8d.
2½ inch	9d.
3 inch	10d.

14. **Ribbed Plug In Coil Formers.** 1¼ inch diameter. Ideal for all wave receivers, etc.

4 pin	2/- each
5 pin	2/3 each
7 pin	2/9 each

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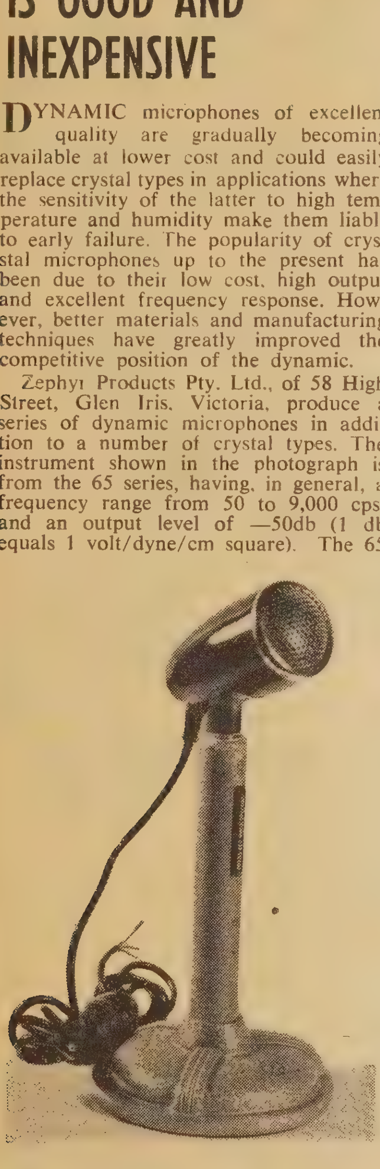
TRADE REVIEWS AND RELEASES

ZEPHYR MICROPHONE IS GOOD AND INEXPENSIVE

DYNAMIC microphones of excellent quality are gradually becoming available at lower cost and could easily replace crystal types in applications where the sensitivity of the latter to high temperature and humidity make them liable to early failure. The popularity of crystal microphones up to the present has been due to their low cost, high output and excellent frequency response. However, better materials and manufacturing techniques have greatly improved the competitive position of the dynamic.

Zephyr Products Pty. Ltd., of 58 High Street, Glen Iris, Victoria, produce a series of dynamic microphones in addition to a number of crystal types. The instrument shown in the photograph is from the 65 series, having, in general, a frequency range from 50 to 9,000 cps. and an output level of —50db (1 db equals 1 volt/dyne/cm square). The 65 M.A. is fitted with an internal transformer intended to feed into a 1 to 5 meg. load while the 65 M.D. feeds directly from the voice coil at 50 ohms. Transformers for 200 and 500 ohms output impedance are also available.



The Zephyr type 65 microphone. The stand shown is also available from Zephyr and has a "press to talk" switch.

While the high impedance microphone with built-in transformer will be found very suitable where a rugged unit is required with valve amplifiers, the low impedance types should be useful with transistor public address amplifiers. The 65 M.D., for example, could feed into the base circuit of a transistor direct from the 50 ohm voice coil and save the cost of the matching transformer.

Tested in our laboratory, the microphone appeared to do everything claimed of it by the manufacturers.

Retail price, including tax, of the 65 M.A. is £11/0/7 and the 65 M.D., without the transformer, is £8/1/10.

The review sample from Jacoby Mitchell, the N.S.W. distributors

One of the most interesting features of the Thorens pickup arm is a screw-adjustable counterbalancing system which permits adjustment of stylus pressure for all pickup heads.

THORENS' PICK-UP ARM IS WIRED FOR STEREO CARTRIDGES

Audio Engineers, of Kent St., Sydney, have available a new pick-up arm made by Thorens which should prove attractive to stereo enthusiasts who are looking for a good support for their stereo cartridges.

THE arm is similar to one used on the standard Thorens players, and is of the usual high quality associated with all Thorens products.

It is finished in hard enamel, black for the head and base, and grey for the arm itself.

The plug-in head is actually a shell into which any of the standard cartridges should be mountable, and is particularly suitable for the Ronette stereo cartridge.

An excellent feature are the stout prongs which engage the arm socket. These ensure a good contact and firm mount.

There is a spring adjustment for stylus pressure, an ingenious and simple worm and gear arrangement easily accessible with the arm in place. The arm can be lifted into a vertical position for this adjustment, and for easy removal of the cartridge.

There is a brake mechanism built into the base which can be connected to a simple lever by the handyman, and which locks the arm when applied.

Only omission is an arm rest, but a hole is provided in the head, and a rest can easily be improvised.

Altogether an excellent product with a retail price of £8/5/9 including tax.

Miniature Tuning Unit

ONE of the neatest tuning units, suitable for crystal and small transistor sets, we have yet seen was recently made available for review by Jacoby, Mitchell and Co. P/L, of 469 Kent Street, Sydney.

The overall length of the inductor and permeability tuning mechanism is only 2in.

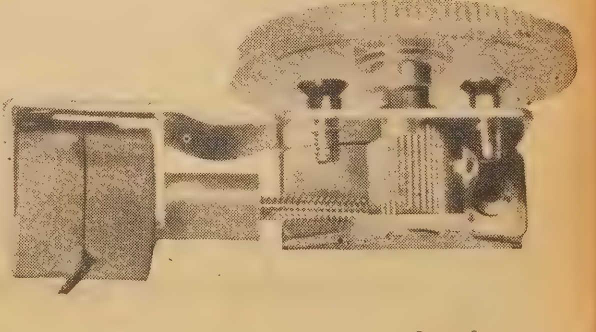
The unit is of Japanese origin and covers the standard broadcast band between 530 and 1600 Kc when a 150 pF fixed capacitor is placed in parallel with the winding. The usual variable tuning capacitor is not required. A 1¼in diam. calibrated plastic dial is included in the price of approx. £1 retail.

From the same original source, Jacoby Mitchell are also able to offer a basic kit for a pocket superhet receiver for a cost of approx. £6/10/. The kit consists of a ferrite rod aerial, oscillator coil, tuning capacitor, dial, 3 IFT's, audio driver and output transformer.

☆

This miniature tuning unit consists of a tapped coil, permeability tuning mechanism and dial. It could be used in a crystal set and, given a suitable circuit, a regenerative transistor set.

☆



TECHNICAL DATA FROM MULLARD

Mullard have always paid great attention to the quality of their technical data service, and have done excellent work in assisting in the intelligent use of their products.

THE attention of readers is drawn to the fact that a number of technical publications are available, free on request, from Mullard-Australia Pty Ltd. of 35 Clarence Street, Sydney.

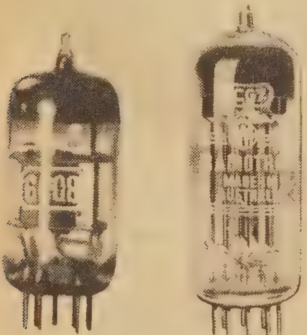
Four-page leaflets with full constructional details including parts lists and detailed line drawings showing placement of small components are available for the following projects: 3 valve 3 watt quality amplifier, 5 valve 10 watt quality amplifier, 5 valve 20 watt quality amplifier, single valve pre-amplifier (crystal pickup), 2 valve preamplifier and 3 valve preamplifier.

A pad containing 360 valve test stickers is also available to service organisations. Space is provided on each sticker to print all necessary data on the valve's test condition. Special care has been taken in the choice of the gum to ensure that the sticker will adhere to valve envelopes.

TWO NEW RADIOTRONS ARE NOW AVAILABLE

TYPE 6CQ8 contains a medium-mu triode and a sharp-cutoff tetrode in the one envelope and is intended for a variety of uses in television receivers but particularly as a frequency converter. In addition to its use as a mixer, the tetrode unit will find application as a video amplifier, IF amplifier and sound IF amplifier.

The triode unit, which has a gm of 8mA/V will be found useful as a phase splitter, sync-clipper, sync-separator and RF amplifier as well as a VHF oscillator.

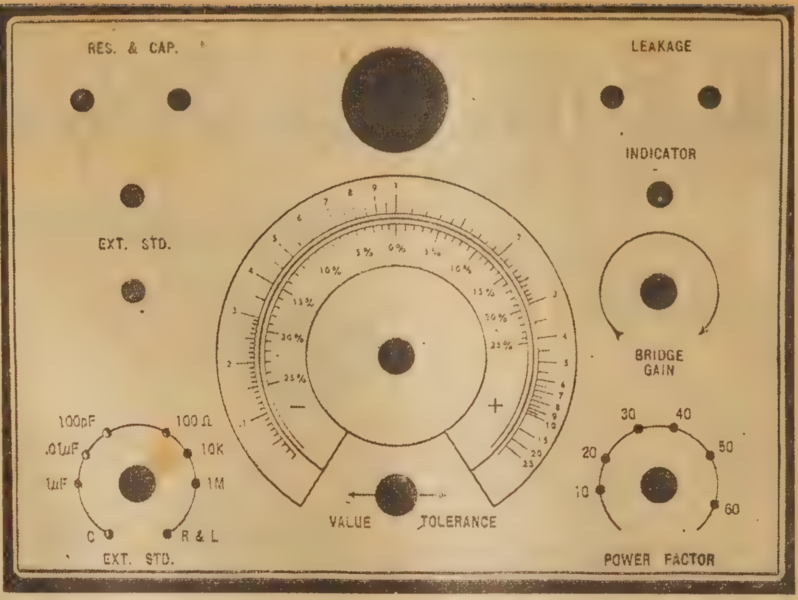


6CQ8 and 6CG7

An internal shield provides effective shielding between the two units.

The 6CG7 is a general purpose medium-mu twin triode designed especially for use in the horizontal and vertical oscillators of TV receivers. The heater power is adequate to ensure long life under high-pulse cathode current conditions.

As with the 6CQ8, an internal shield is included between the two units.



Instrument panel well finished

R. H. Oxford and Sons Pty. Ltd., announce that the etched labels which they have previously made available for a wide range of instruments will, in future, be supplied in two styles.

THE previous style, nickel lettering on a black background, will be retained for both existing and new designs, while these will also be available in the new style.

The first sample of this (pictured above) was for the R.C. Bridge described in the September, 1958, issue, and is a particularly attractive and well-finished panel. The finish is of natural (though protected) aluminium, with the lettering filled with a variety of colours. In addition to making the panel more attractive, this assists materially in picking out various ranges and functions.

Further details, including price, from the makers, 97 Marriott Street, Redfern.

ACOS HAS TURNOVER STEREO PICK-UP

Acos have reported great interest in their new turnover stereo. cartridge which is now available.

STRICTLY speaking it is not a turnover cartridge, because the cartridge as such does not turn over.

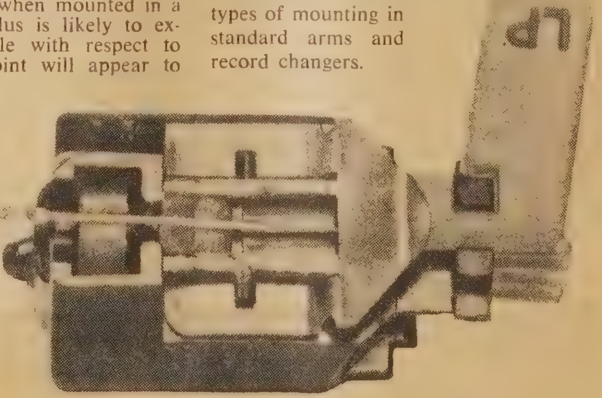
It is the stylus which turns.

One side of the flattened end of the long rod stylus carries a 78 r.p.m. stylus and the other a 0.5 mil stylus for stereo and monaural microgroove records.

The same crystal units are thus used in both cases and the support and damping of the stylus are not disturbed.

One rather revolutionary point about the cartridge is that, when mounted in a suitable arm, the stylus is likely to exhibit a negative angle with respect to the disc—i.e., the point will appear to "dig in" to the groove. The manufacturers make the point that, because the tip of the stylus may be considered as spherical, it is immaterial whether the stylus has a positive or negative angle, which in either case may be as great as 20 degrees.

The Acos stereo pickup is an excellent one and was first used in our highly successful stereo experiments and demonstrations. It is available in three versions to suit all types of mounting in standard arms and record changers.



The Acos stereo. pickup has a number of novel design features.

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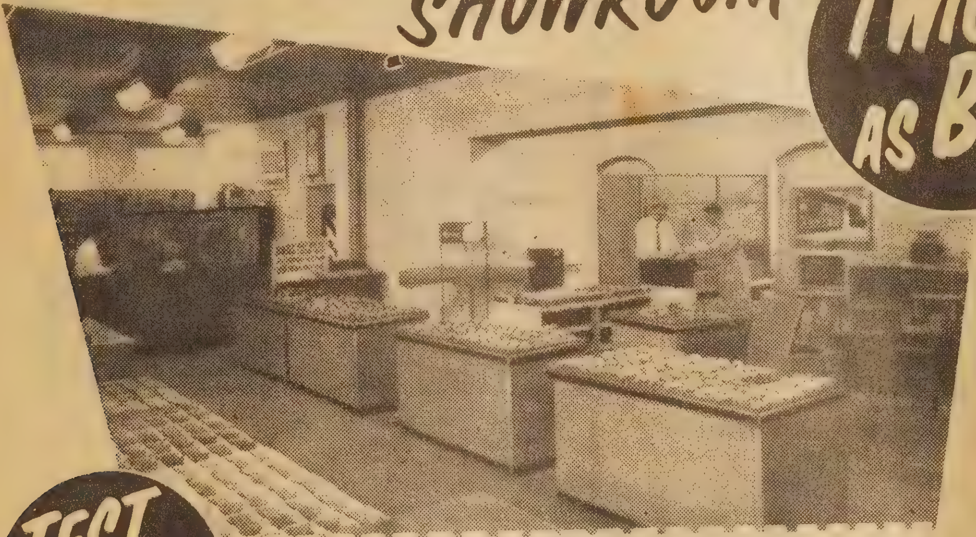

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SPECIALISTS in HIGH-FIDELITY AND STEREOPHONIC EQUIPMENT!

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208 LT. LONSDALE ST. MELB. FB 3731—SEE NEXT FOUR PAGES!

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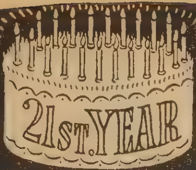

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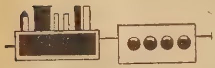

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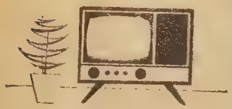
A complete A. & R. range for the ultimate in performance for Hi-Fi and P.A. Systems.



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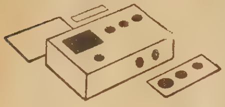

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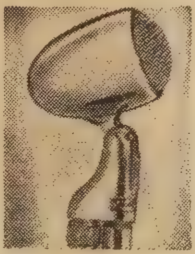

GS210 , and GS210/L Streamlined, chrome finish, filtercell, high or low impedance.

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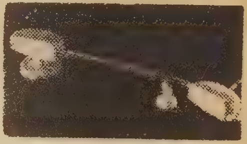

FF2-OV, FF2-P "Fonofluid" turnover crystal pickup with alternate response characteristics.

The AWA range of accessories is available at Magraths !

Price: £26/15/6

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RECOMMENDED
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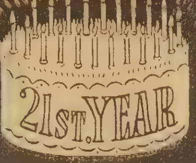

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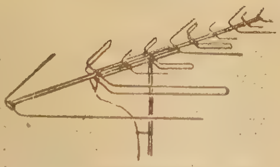

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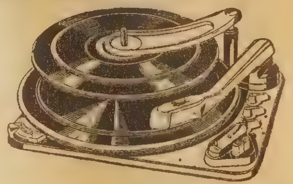

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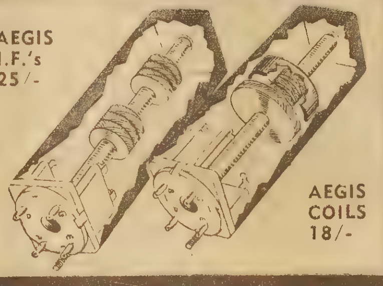

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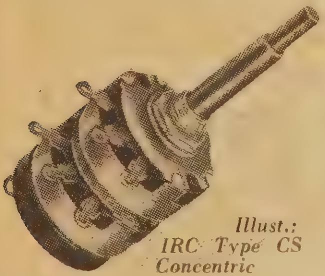

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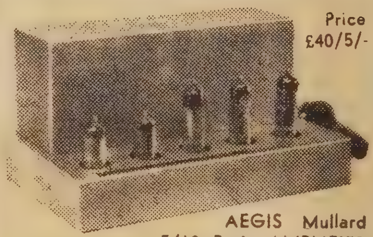

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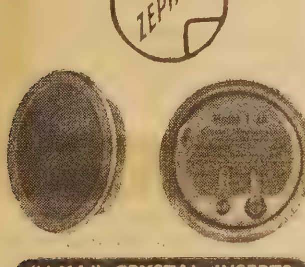

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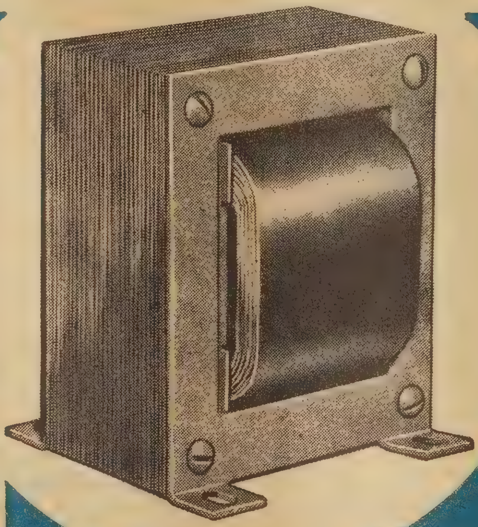

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

MORE ABOUT AMPLIFIERS FOR USE IN CHURCHES

There has been a good deal of interest in the problems of installing sound systems in churches in recent months. We hope we have answered many of the queries in our articles on the subject in the November and December 1958 issues. However, a reader from East Malvern, Vic., Mr H. Pfeifer has some more to say on the subject.

HE says: "I wish to pass on to other readers some of my experiences in the installation of a system of sound amplification and hearing aids in a church. Although the job is not quite completed, excellent results are being obtained.

"I am using an amplifier wired to the circuit of the portable 10-watt PA system described in Radio, Television and Hobbies, but with a second microphone preamplifier to enable two microphones to be used. The output transformer is a commercial 10,000-ohm push-pull to 50 or 200 ohm line obtained for 35/ from a Melbourne firm."

A sound column was considered desirable and suitable dimensions for a column using four 5in loudspeakers is 2ft high, 7in wide and 4in deep.

"Hearing aids are made from single earphones of a light weight type, obtained for about 25/ per pair. These are of a German make and although I have made no tests on their frequency response, it is such as to give quite good results. The volume controls for the hearing aids are 10K miniature potentiometers obtained for 2/ each from another Melbourne advertiser. These are a little higher resistance than usual but their control of volume is quite smooth. A resistor could be wired in series with each earphone to reduce the loading on the circuit at full volume, 5K being a suitable value.

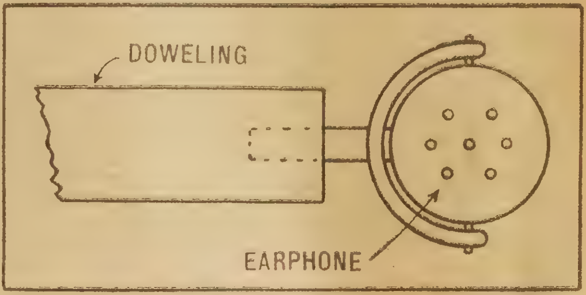
EARPHONE FITTING

"The earphones are fitted to varnished pieces of dowelling drilled to take the fitting by which the earphone is fixed to the headband as per the drawing This results in a very neat job.

"I found that the sound from the loudspeakers was much easier to understand if the bass response was reduced to an extent where a person going from the main church building to another room where there was a loudspeaker (at a time when the microphone was picking up music from an organ), could cause a slight drop in level of bass frequencies. As pointed out in your article, the improvement in sound distribution more than offsets this uneven frequency response.

"I also found that persons having dif-

(Continued on Page 119)



Method of mounting the headphone. Each original pair of phones serves for two members of the congregation.

LOW COST ENERGISER FOR BRIDGE

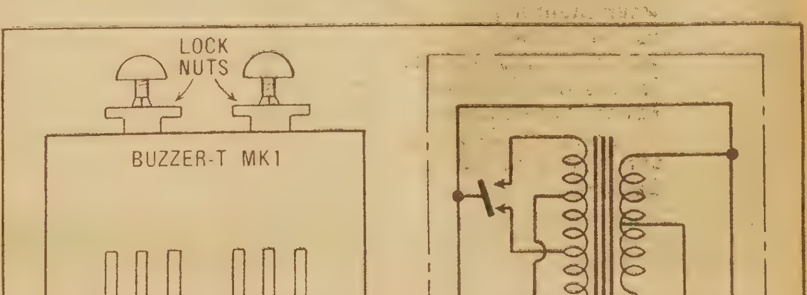
Mr R. Lions of Haberfield, N.S.W., has an interesting point to make regarding the use of disposals buzzer units. Incidentally, these buzzers are of excellent quality and very suitable for morse code practice.

MR LIONS' idea was inspired by an article which appeared on page 23 of the March, 1957, issue, which suggested the use of transistors to energise a capacity bridge. Since the buzzers are available cheaply, the overall cost of the bridge will be greatly reduced.

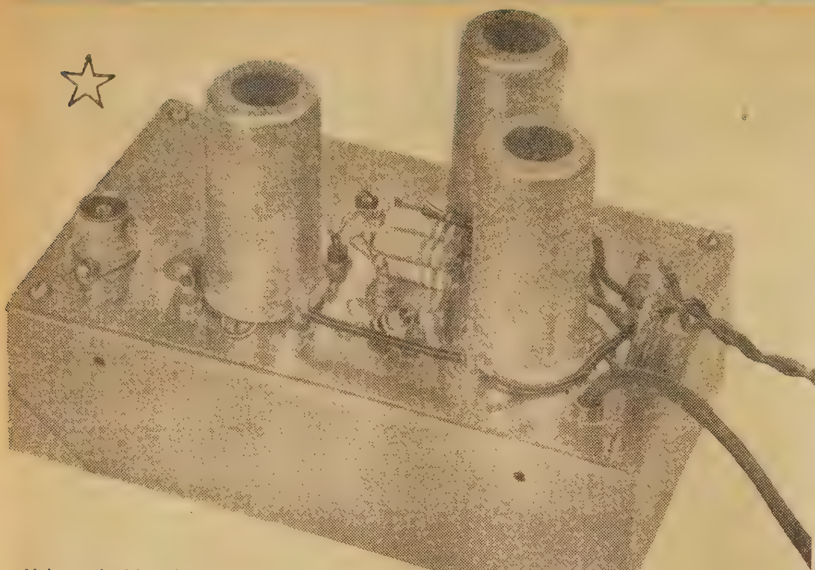
Our correspondent says: "This is a buzzer used in most ex-Army phone gear. It is variable and there is a second winding which is used for the output to the bridge circuit. The diagram is almost self-explanatory.

"A low resistance phone was used as the bridge indicator and the null was heard quite plainly.

"It is better if the buzzer itself is muffled so that the sound the contacts make is not so great."



Circuit and diagram of the Army disposals buzzer. For morse practice, the headphones would be connected to terminals 1 and 2 and the key in series with the battery.



General view of the 144 Mc crystal-controlled converter.

Valve shields, wiring components above the chassis plate, power leads, output coax, and input connector are visible in this photograph. Brass chassis plate is 5⅝in by 3½in. It is mounted in a metal box 1¾in deep with a removable baseplate. A cover with ventilating holes would be a worthwhile addition. This should allow a clearance of about 2¼in.

A Crystal Converter For The 144 Mc Band

First class results at minimum cost are assured with the 144 Mc crystal controlled converter described here. Sponsored by the VHF and TV Group of the Wireless Institute of Australia, N.S.W. Division, it has since been successfully completed by dozens of widely separated Institute members. The converter shown in the photographs was made in our own laboratory, and the article prepared from our own notes and those of the designer, Bob Winch, VK2OA.

by Maurice Findlay

ONE of the objects of the VHF and TV group is to foster interest in VHF affairs. Lots of prospective amateurs and listeners may have been turned away from the VHF bands because of a mistaken idea that there is something mysterious or particularly difficult about the equipment and getting it to work.

It is true that the techniques required are different from those on the normal high frequency bands in that care has to be taken with inductive and capacitive components which would be insignificant at say, 3.5 Mc.

CHANGES FREQUENCY

A converter is a relatively simple device and in an elementary form could consist of a single twin triode valve. However, when it serves its purpose of transforming the incoming 144 Mc signal to an equivalent signal within the tuning range of an ordinary HF receiver, all the facilities of the latter are available for 144 Mc reception.

For example, if the lower frequency receiver is fitted with a signal strength meter, this can be used to measure the relative strength of 144 Mc stations. Selectivity, audio power output, and to a large extent gain, are mainly determined by the basic communication receiver, which, by the way, may be used for its normal purpose at any time simply by disconnecting the output terminals of the converter from the receiver aerial terminals.

The signal-to-noise ratio of the combination is determined largely by the characteristics of the converter and the design of the input stage is important in this respect. Assuming that the stability of the communication receiver is good, the frequency stability of the combination will be determined mainly by the frequency stability of the high frequency oscillator in the converter.

For amateur work, we are interested in receiving over a band of frequencies, in fact, from 144 to 148 Mc, and in order to do this we could vary the frequency of the converter's oscillator. In a typical case, the tuning range would be 154 to 158 Mc to cover the amateur allocation. An excellent practical example of a converter working on this principle appeared in the March, 1953 issue of "Radio, Television and Hobbies."

EXAMPLE

Assume that the oscillator in the converter is fixed at 154 Mc and the receiver at 10 Mc. The system is sensitive to incoming signals at 144 Mc. To tune a signal at 145 Mc, the communication receiver could be tuned to 154 minus 145 equals 9 Mc. By similar reasoning, you can work out that in order to tune from 144 to 148 Mc, the receiver will have to tune from 10 to 6 Mc.

Although excellent results can be obtained with a carefully designed tunable converter, it is often easier to employ a fixed high-frequency oscillator and tune over the band by varying the tuning of the communication receiver. The VHF converter need not have a dial or any other controls, for that matter. If it should be more convenient mechanically, the converter can be placed well away from the operating bench and connected by a length of co-axial cable.

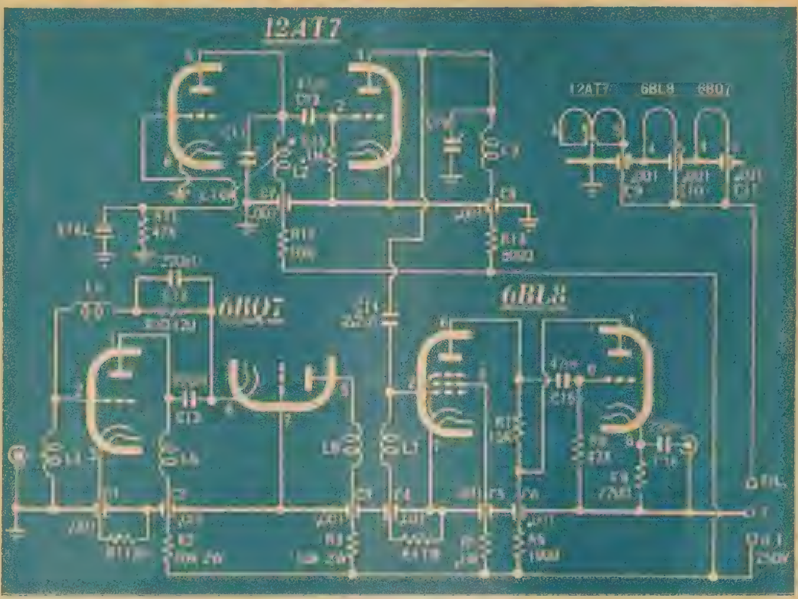
If the oscillator in the converter had been adjusted to 134 Mc instead of 154 Mc, the communication receiver would have had to be tuned from 10 to 14 Mc, i.e., increasing the frequency of the communication receiver increases the frequency of the input signal. This is highly desirable and is the reason why most VHF converters of this type operate with the oscillator on the low side of the signal.

CRYSTAL STABILITY

Perhaps the most important advantage of the type of converter with the fixed high frequency oscillator is that the oscillator can be crystal controlled. Quartz crystals suitable for fundamental operation at 134 Mc or thereabouts are not normally available and it is usual to operate the crystal oscillator at some lower frequency and use a frequency multiplier system to obtain output at the desired frequency.

By the standards of normal self-excited oscillators, the frequency stability

144 Mc XTAL CONVERTER CIRCUIT



A feature of the converter is effective bypassing to the chassis plate with lead-through type ceramic capacitors. The chassis plate is indicated above by heavy lines.

of crystal controlled oscillators is very good, indeed, and these standards can be maintained without the need for special mechanical stability in the assembly of the oscillator and without voltage regulation.

Most of the drift which occurs in the system can usually be attributed to the communication receiver and as this is usually very good at frequencies up to about 20 Mc, the overall calibration can be maintained with good accuracy.

We mention these points as background for the benefit of readers with little previous experience in VHF receiver design. When the 144 Mc converter project came up for consideration by the W.I.A.'s VHF Group no doubt most of them were considered to be axiomatic.

The project was to turn the theoretical ideas into a practical converter, with good performance, easy to duplicate, and inexpensive.

ORIGINAL DESIGN

Much of the credit for the project goes to Mr Bob Winch, who operates an experimental station with the call sign VK2OA. Mr Winch designed and constructed the original prototype converter and prepared the coil and layout information which is published here.

Economy has been achieved without prejudicing performance by employing three dual purpose valves. Looking at the circuit, the valve at the top is a 12AT7 twin triode, the respective sections of which function as a crystal oscillator and a frequency multiplier. A 6BQ7 double triode appears at the lower left. This valve was specially designed as an RF amplifier in television receivers, a function which it performs with excellent efficiency in the present converter.

The pentode section of the 6BL8, at the lower right, accepts both the output from the frequency multiplier and the amplified signal from the aerial, mixing them to produce the intermediate frequency. The latter is fed to a cathode follower which behaves as a wide band impedance transformer delivering its low impedance output to the aerial terminals of the communication receiver.

CRYSTAL REQUIREMENTS

An ordinary quartz crystal with a fundamental frequency between about 5 Mc and 9 Mc is used with one half of the 12AT7 to form a crystal oscillator. The circuit is special in that it permits the crystal to oscillate at three times the marked frequency and no energy appears at either the fundamental or the second harmonic.

Two important advantages of the circuit are that the number of multiplier stages is reduced and that crystals which would normally place harmonics within the tuning range of the receiver can be used.

The circuit is a little more difficult to adjust than an ordinary straight crystal oscillator but when it is working correctly is perfectly reliable and stable. It has frequently been used in VHF equipment described in overseas publications.

Output from the crystal oscillator is capacitively coupled to the grid of the second half of the 12AT7 which behaves as a class C frequency multiplier delivering output at a frequency 5, 6 or 7 times the input frequency, depending on the frequency of the crystal fundamental and the range of first intermediate frequencies it is desired to use. The harmonic required is selected by adjusting the output tuning capacitor (C19).

Output from the frequency multiplier is coupled to the grid of the 6BL8 pentode mixer via a small value capacitor (C14). There are some advantages in inductive coupling but the capacitive arrangement makes for simple construction.

Signals from the aerial are coupled via L4 to the grid of one of the 6BQ7 triode sections. The design of L4 is particularly important because it is a major factor in determining the signal-to-noise ratio of the system. You will note from the coil data that the tap is well up the coil, despite the fact that the impedance of the co-axial cable will normally be 50 or 75 ohms.

The two triode sections of the 6BQ7 are connected in a "cascode" (cathode coupled cascade) circuit. Compared with the pentode, which is normally used in lower frequency receivers, the cascode has the advantage of much lower noise level and is easier to design for freedom from oscillation. Gain of the two triode stages is about the same as a single pentode.

Since the following receiver normally has plenty of gain, the most important advantage of the cascode is its low noise level.

Looking into the cathode of the second 6BQ7 section, the impedance is low and therefore the gain of the first section is low.

Despite the high capacitance between the grid and plate of the triode, the stage would probably not oscillate with-

PARTS LIST

VALVES
1 6BL8, 1 6BQ7 and 1 12AT7.
CRYSTAL
See text.
RESISTORS
R1 120 ohm 1 watt.
R2 10K 2 watt (2 x 22K 1 watt).
R3 10K 2 watt (2 x 22K 1 watt).
R4 1 meg ½ watt.
R5 0.1 meg ½ watt.
R6 1000 ohms ½ watt.
R7 15K ½ watt.
R8 47K ½ watt.
R9 2,200 ½ watt.
R10 120 ohm ½ watt.
R11 47K ½ watt.
R12 10K ½ watt.
R13 5,000 ohm ½ watt.
R14 0.1 meg ½ watt.

CAPACITORS
C1 to C11 .001 uF ceramic lead-thru.
C12 220 pF ceramic disc.
C13 220 pF ceramic disc.
C14 2.2 pF ceramic tubular.
C15 47 pF ceramic tubular.
C16 220 pF ceramic disc.
C17 3 to 30 pF trimmer.
C18 47 pF ceramic tubular.
C19 0.5 to 3 pF ceramic trimmer.

SUNDRIES
30 SWG enam. wire. 20 SWG enam. wire, 18 SWG tinned copper wire, sheet brass for chassis plate and metal for case if required, crystal socket, 3 9-pin miniature sockets with shields, 3-lug tag strip, co-axial socket, 3ft co-axial cable, ⅛in nuts and bolts, etc.

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12v.	500v. 350mA	£8 10 0
12v.	1200v. 200mA	£6 10 0
24v.	250 v. 100mA. New	£2 0 0
12v.	235v. 50mA	£2 15 0
12v.	350v. 50mA	£2 15 0

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out neutralisation. However, regenerative tendencies prejudice the noise figure of the system and a neutralising inductor (Ln) is included.

The second triode section is operated as a grounded grid amplifier, with the advantage that the grid acts as a shield between the input and output circuits and no neutralisation is required. Plate-to-grid capacity of the valve plus strays resonate with L6 at 144 Mc. There is little damping on the circuit, it tunes relatively sharply.

It would have been possible to achieve a similar noise figure using a single triode as a grounded cathode amplifier feeding into a high impedance load. However, in this case the adjustment of the neutralisation would have been very critical. The noise figure is prejudiced if the circuit becomes regenerative and therefore the cascode is the preferred circuit.

BANDPASS COUPLING

Coil L7 in the grid circuit of the 6BL8 pentode mixer section couples with L6 to form a bandpass transformer. It is resonated at approximately 144 Mc with stray and the input capacity of the valve. Most of the signal frequency selectivity of the converter is contributed by the bandpass transformer.

From the noise standpoint, a triode mixer would have been preferred to the pentode. However, the gain of the cascode is sufficient for the noise contributed by the mixer to be unimportant and it does require less injection. Had more injection been needed, a more complicated multiplier chain between the crystal oscillator and mixer may have been required.

The equivalent source impedance of the mixer output is high while the input impedance of a communication receiver aerial terminals is normally low. Therefore, for an efficient transfer of energy from the mixer to the receiver some form of coupling device is required.

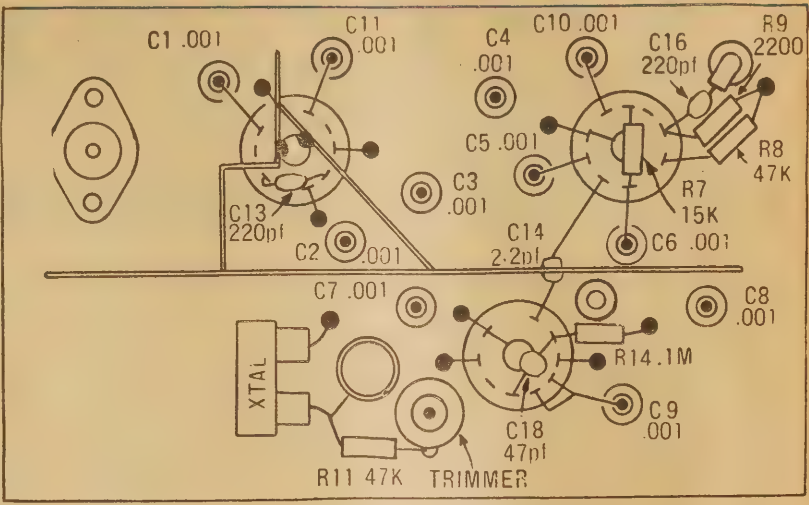
In the case of the "Radio, Television and Hobbies" converter mentioned earlier, a tuned transformer was connected in the plate circuit of the mixer valve. This provides excellent efficiency but because of the selectivity of the tuned circuit is suitable for operation only at a single frequency.

OUTPUT CIRCUIT

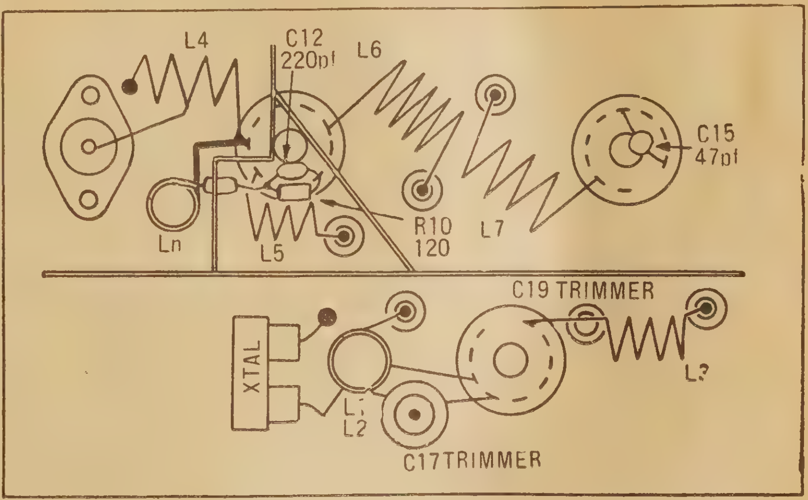
Cathode follower amplifiers have a high input impedance and a low output impedance. Use is made of these properties in the converter where the grid of the 6BL8 triode section is connected, via a blocking capacitor, to the plate of the mixer section. Output at the same order of voltage, but with a low source impedance appears at the cathode from where it is passed on to the communication receiver. No tuned circuits are involved and the cathode follower works with good efficiency over a wide range of frequencies. The input impedance of the communication receiver can be any normal value, usually between 50 and 600 ohms.

Construction of the converter will begin with the preparation of the chassis plate which must be made from metal which solders easily. We suggest 20 or 22 gauge sheet brass, which takes a tinning easily and is not so thick that

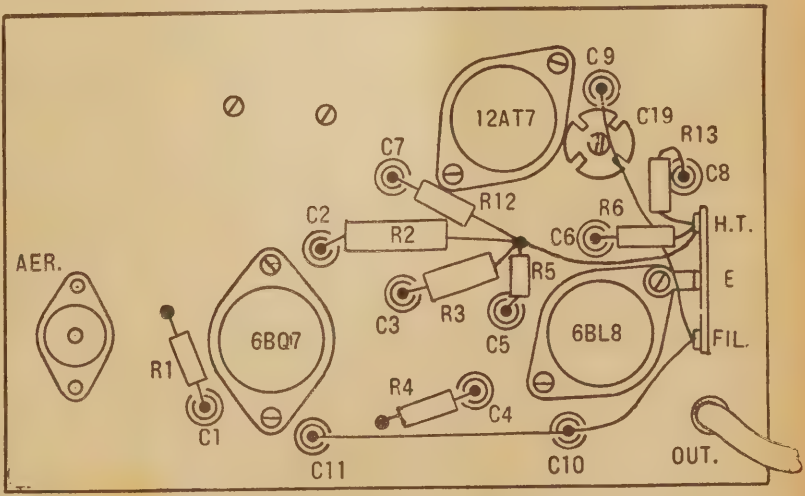
DETAILS OF CONVERTER LAYOUT



Placement of components below the chassis is shown here. We suggest that you adhere as closely as possible to this layout.



Coils should be positioned according to this diagram after the small components (above) have been fitted.



Parts above the chassis plate may be placed in the position most convenient mechanically. The above is one example.

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a great deal of heat is required. Lighter gauges may tend to be too flexible. Use of a high tin content solder (60/40) will avoid undue spreading of the solder over the chassis, which must be made at a high temperature for good soldering.

Details of holes are given in the drawing. Note that the mounting hole for C19 should be filed to 3/16in square to take the square end of the capacitor body. A special high capacity ceramic trimmer with the same physical dimensions was used for C17 in the original converter, but we found it easier to buy a standard 30 pF trimmer.

Cathode resistors and voltage dropping resistors not primarily concerned with the high frequency circuitry are mounted above the chassis plate. Connections between the top and bottom of the chassis are made via .001 uF high permitting ceramic capacitors. This type of construction results in an extremely low series inductance and ensures that vital parts of the circuit are effectively bypassed.

WIRING IN WORDS

Information on the wiring and assembly of the converter appeared in a step-by-step form in the sheets issued to Wireless Institute members and, no doubt, readers will find it helpful. The steps are as follows:

1. Mount the valve sockets and coaxial input connector.

2. Bend down the following pin connections until they touch the chassis and solder them thereto:—6BQ7—4,7 and 9; 6BL8—4 and 7; 12AT7—3, 8 and 9. Using short pieces of wire, connect the centre spigot of each socket to one of the earthed lugs.

3. Prepare to mount the lead through capacitors and the coaxial output cable by tinning around each hole on the underside of the chassis. The lead through capacitors are inserted in their respective holes from the bottom of the chassis with their longer half above the chassis. By using a hot iron and flowing the solder, the capacitors are soldered into place.

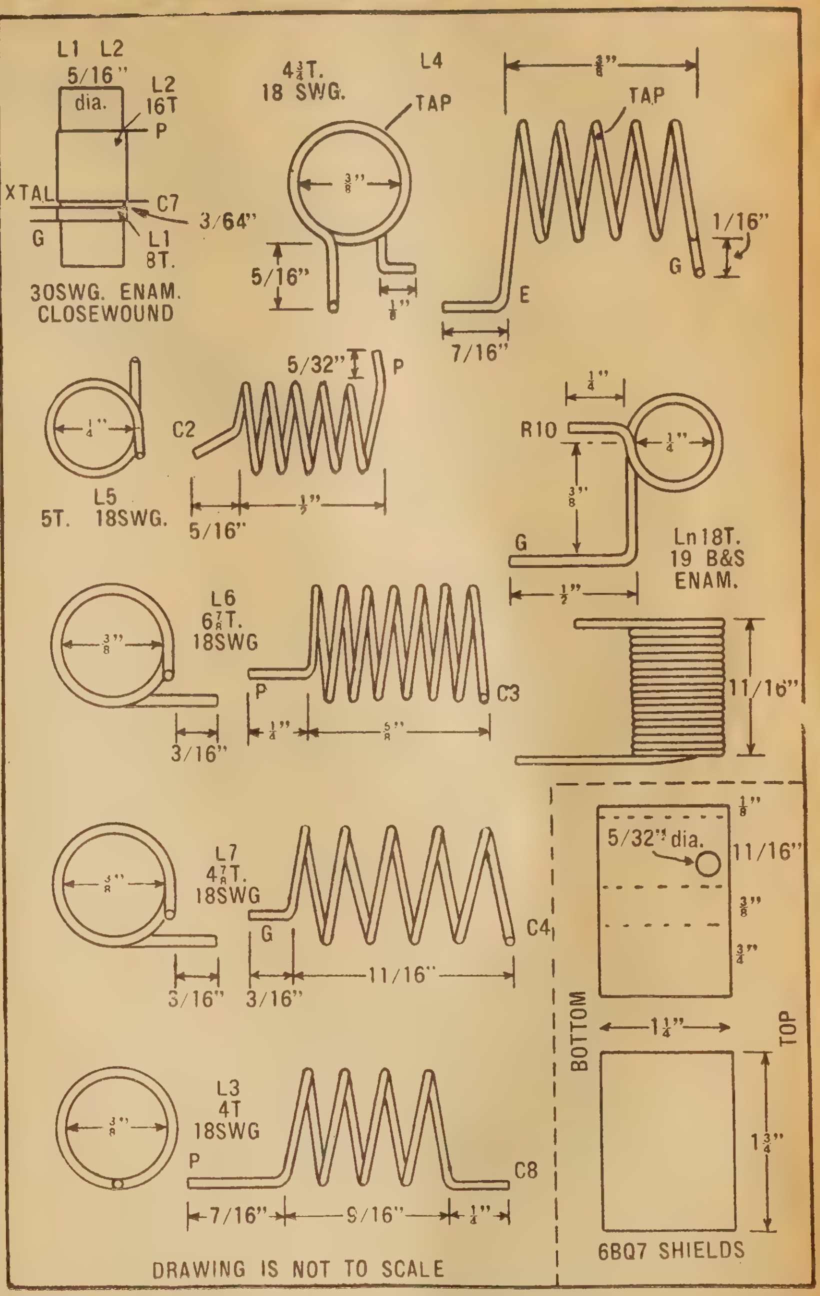
4. The following connections are now made by bending the centre connection of the lead through capacitor and the appropriate lug on the valve socket toward each other until they overlap and then soldering them together: 6BQ7—3 to C1, 5 to C11; 6BL8—1 to C6, 3 to C5, 5 to C10; 12AT7—4 and 5 to C9. An additional short length of wire may be required in the latter case.

CUTTING CABLE

5. Prepare the co-axial cable by cutting off ½in of the vynil outer covering from one end, then pushing back the braid until it forms a flange and tinning this flange. Remove ¼in of the polythene insulation from the central conductor. Thread the other end of the cable through the hole from the underside of the chassis until the flange comes up against the chassis. Using a hot iron and working quickly, solder the flange to the chassis.

6. Mount the crystal socket C17 and C19. To mount C19 remove the adjusting screw and locking nut. Insert the ceramic body into the square hole from the underside. Replace the screw and locking nut from the top and then lock the assembly into place by screwing down the locking nut. The crystal socket is mounted on its side by a 1-8th inch Whitworth screw.

FULL DIMENSIONS OF ALL COILS



Details of converter coils. Data for L1 and L2 are different from those originally suggested by the W.I.A. in order to allow a standard 5/16in former to be used. Also, it was found in our converter that neutralisation was obtained with 22 turns on Ln. All other coil dimensions should be followed exactly.

7. Mount C13 across pins 1 and 8 of the 6BQ7. Both pins should be bent slightly outward.

8. Form L5 according to the dimensions shown in the diagram and mount on pin 1 and C2.

9. Join C12 across R10 and connect one end to pin 8.

10. The next job is to mount the shields across the 6BQ7 socket. Bend the Z-shaped shield as shown in the template and position it as shown in the layout diagram. Solder the flange to the centre shield. Then solder the shield to the centre spigot of the socket and spot the end to the chassis where pin 4 earths. Now position the second shield and solder it to the centre shield and the Z shield.

11. Push the free end of R10 through the hole in the Z shield, thread the three beads on to the wire, push them hard up against R10 and form a small loop in the wire to hold the beads in place.

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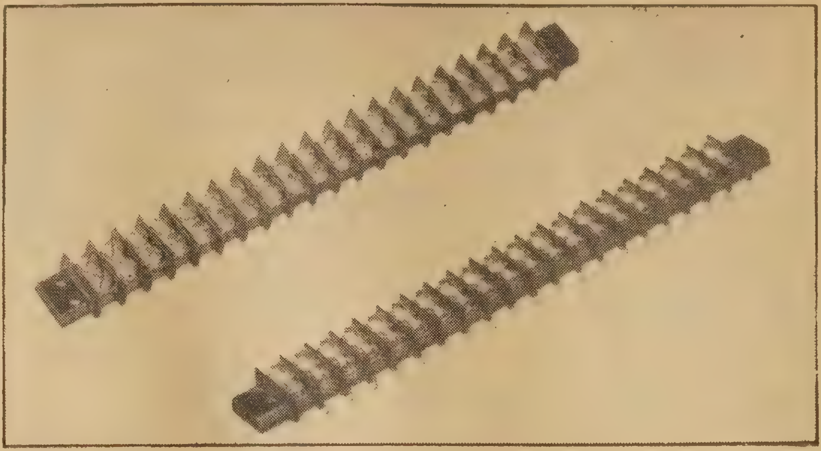

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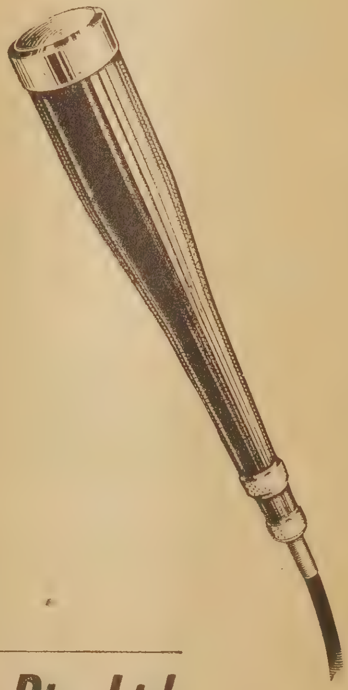

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12. Complete the under-chassis wiring by wiring in R7, R8, R9, R11, R14, C14, C15, C16, and C18, earth the other side of the crystal socket and join the hot leads from C17 and C19 to their respective points.

13. Turn the chassis over and connect the filament terminal C9, C10 and C11 together.

14. Wire in R1 and R4.

15. Connect one end of R2, R3, R5 and R12 to their respective lead through capacitors. Join the four leads together and run a wire to the H.T. terminal.

16. Wire in R6 and R13.

Careful consideration should be given to the choice of crystal frequency because it affects the tuning range of the communication receiver. There are firms advertising in radio publications who are willing to grind a crystal to a specified frequency for a reasonable sum.

Alternatively, some of the disposals dealers still have stocks of ex-military crystals and you could well be lucky in finding one of suitable frequency.

HARMONIC OPERATION

If specially ordering a crystal for an exact frequency, advise the supplier of the intended circuit since the crystal will oscillate at a frequency slightly different from expectations based on measurements in a straight circuit. The several samples we checked operated at frequencies between 6 and 12 Kc lower than expected, after measuring their frequencies in fundamental operation.

Assuming that the multiplier increases the frequency by a factor of 5 and the frequency change on third harmonic operation is 10 Kc, the change in communication receiver dial calibration will be 50 Kc. This is not a great deal in a receiver covering 4 Mc and in all probability the actual figure will be less than the example.

If ordering a crystal specially, the procedure is as follows: Choose the tuning range on your receiver which you would like to correspond to 144 to 148 Mc. (For example 7 to 11 Mc.) From 144 subtract the number corresponding to the low frequency end of the tunable IF range. This gives the required output frequency for the harmonic amplifier (e.g. 137 Mc). Then divide by 5, 6 or 7 to get the frequency of the oscillator. Divide again by 3 to get the fundamental frequency of the crystal, bearing in mind the previous discussion regarding the behaviour of harmonic oscillators.

BEST MULTIPLIER

Should you choose to multiply by 6 in the harmonic amplifier and use the 7 to 11 Mc range, the required crystal frequency is approx. 7611 Kc. For multiplication by 5, the crystal frequency may be higher than convenient while multiplication by 7 may tend to make the injection a little on the low side.

Alternatively, you may have a crystal which you would like to check for suitability. In this case, you start by multiplying the marked frequency (or a couple of Kc lower) by 3. Then multiply this number by 5, 6 and 7 and note if any of the harmonics fall within the 144 to 148 Mc band. If so, the crystal is not suitable.

If no harmonic falls within the band, note the difference between 144 and the closest harmonic falling below 144. If it is between about 2 and 20 Mc and within the tuning range of your receiver, the crystal can be used. If the lower end of the communication receiver tuning range falls between about 4 and 10 Mc, so much the better.

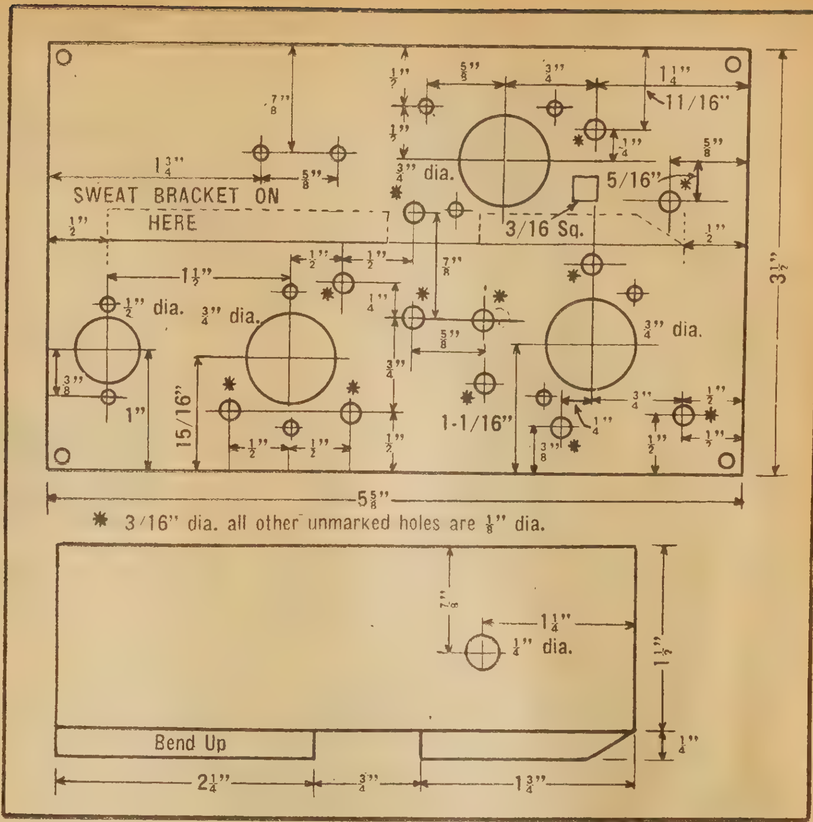
The lowest end of the range mentioned tends to encourage image responses while the deficiencies of most communication receivers tend to show up frequencies greater than about 20 Mc. Also the next higher order harmonic may come within the tuning range, giving rise to unnecessary spurious responses.

The 5th, 6th and 7th harmonics of the oscillator frequency are the only ones which will normally be considered, for the reasons given above, but if you are using a low or high-frequency crystal you will obviously check the 8th and 4th harmonics respectively to make sure that they do not fall within the 144 to 148 Mc range. A slide rule makes it possible to check where the harmonics fall, at a glance.

When checking through stocks for a crystal suitable for the prototype converter, we noted that the greater bulk of available crystals seem to be for lower frequencies and require a multiplication of 7, 8 or 9. This may be an argument for a second version of the converter employing an additional multiplier stage.

The following are some examples of crystals which you could use. In each

(Continued on Page 119)



Dimensioned drawing of chassis plate and the main shield partition. Dimensions of two smaller shields, also required, are included in the coil diagram.

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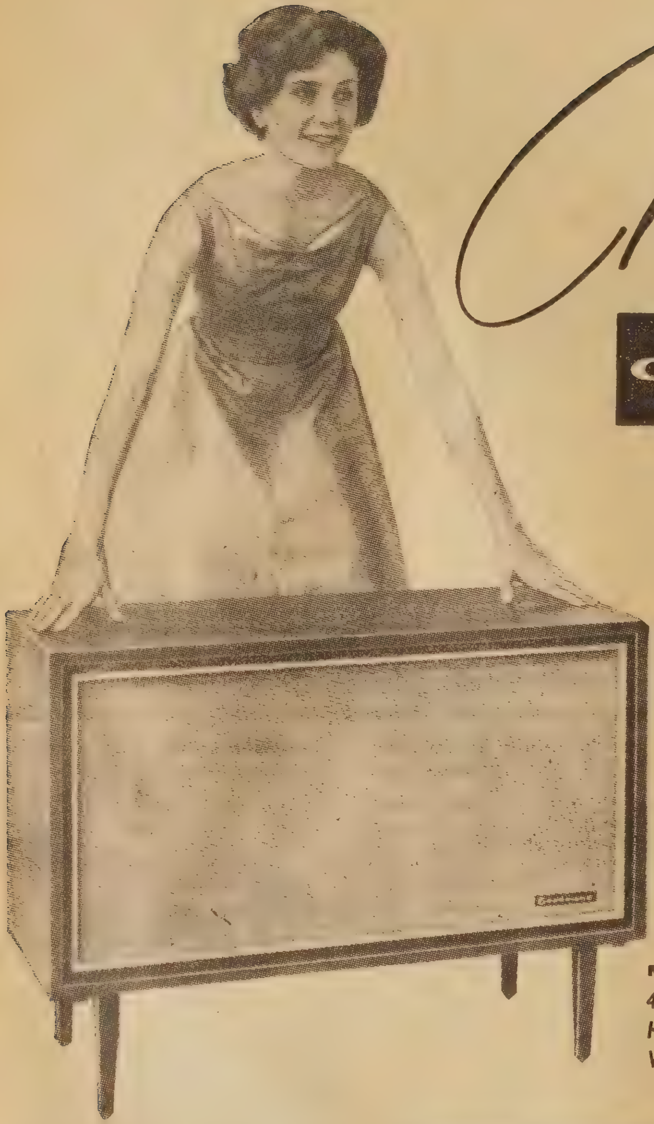

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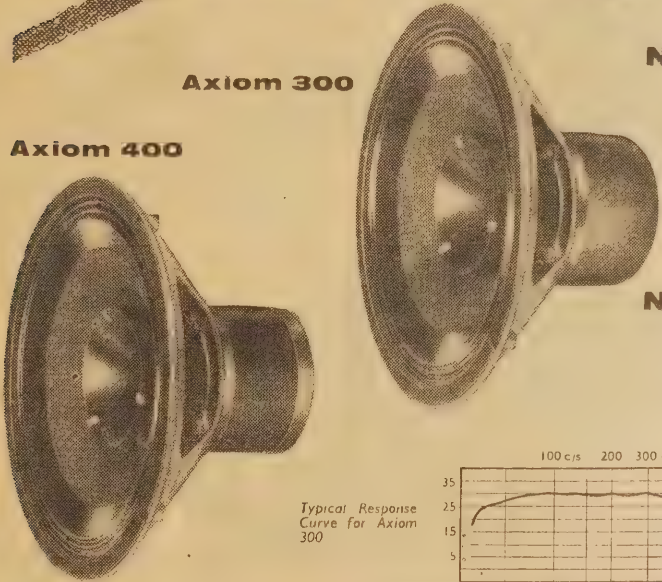
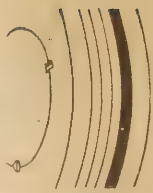


NEW



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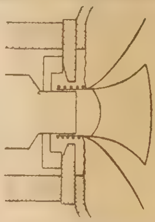

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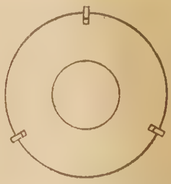

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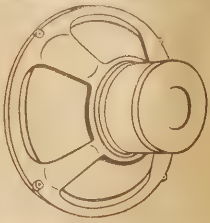

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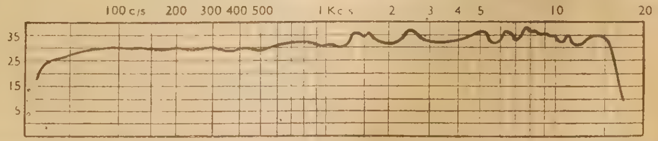

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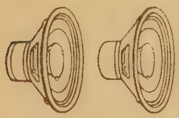

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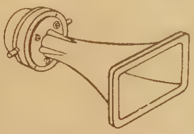

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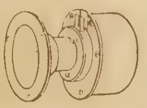

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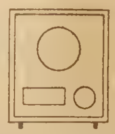

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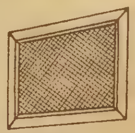

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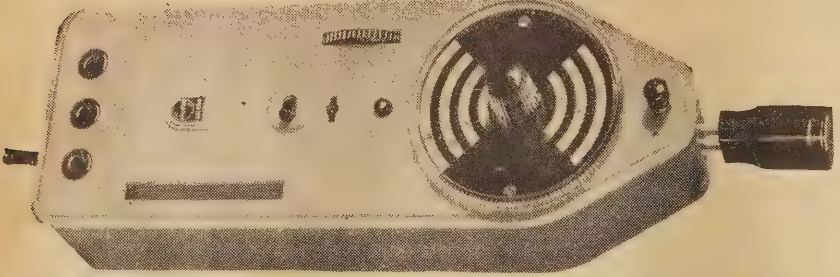

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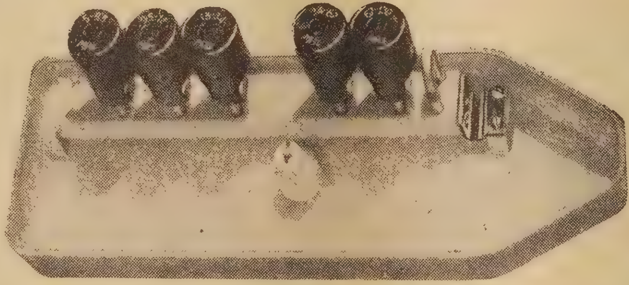

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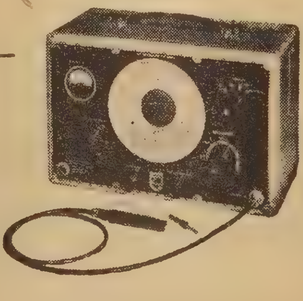

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FROM THE SERVICEMAN WHO TELLS

The longer I service radio and TV sets the more convinced I become that the job would be only half as hard—and half as expensive—if the general public refrained from trying to be "smart"; usually at the serviceman's expense. All my stories show some evidence of this "human" factor.

MY first story this month concerns a rather interesting intermittent in a TV set; interesting not so much because of the nature of the fault, but by reason of the method used to fix it. Although a somewhat unusual approach, it appeared to be perfectly justified in this case.

The story started when the owner entered the shop and wanted to know if I could tell him what would cause his picture to "jump up and down violently." I rather gathered that he imagined it was simply a matter of nominating a particular valve — and that he would probably go off and buy the valve "cheap" from someone else anyway!

Quite apart from the fact that I dislike being taken for a "mug," an accurate diagnosis from such a vague description was virtually impossible, anyway. I told him as much, and pointed out that the only satisfactory way of fixing such a fault would be by checking the receiver thoroughly. At this he somewhat grudgingly agreed that I had better call at his place and have a look at the set on the following day.

FIXED IT HIMSELF

However, early the next morning he telephoned to cancel the appointment. He went on to explain that the fault seemed to be related to some part of the back of the chassis; an assumption based on the fact that he had been able to cure the fault by simply hitting the appropriate part. He hoped he had not inconvenienced me, of course, but felt that, in the circumstances, my services would not be needed.

I smiled as I hung up the phone. I would have been prepared to wager a new picture tube to a dud 5Y3 that he would be back seeking my services again within a few days.

Perhaps it was just as well I didn't, because it was nearly a fortnight before I heard from him again, and I had almost forgotten the incident. However, there was no suggestion of haggling this time. The picture had vanished completely, leaving only a thin, bright, horizontal line across the screen. And could I come this afternoon, please; there was a special program they wanted to see that night.

LIKELY COMPONENTS

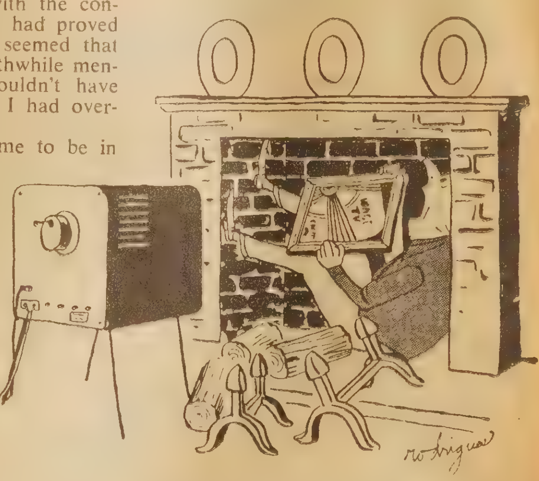
Making sure that I had a replacement horizontal oscillator/output valve, a 6CM7, as it happened, and other likely components that it might be feasible to change on the spot, I set out for the address I had been given.

As I had more or less expected, the 6CM7 turned out to be the culprit and a new one restored vertical deflection in short order. All I had to do was readjust the height and linearity controls to restore the picture to reasonable proportions. I suspect that some not too intelligent fiddling had been going on in regard to these latter, probably during some of the earlier attempts to cure the original fault.

This was substantiated by the next discovery. Flicking from channel to channel I noticed that the frame circuit did not lock on immediately, suggesting that the Frame Hold control was set too close to one of its limits. I reached for the appropriate control on the front of the set, only to discover that this was wobbling around like a drunken reveller on New Year's Eve. What was more, the Line Hold and Contrast controls were in a similar condition.

I pointed this out to the owner, and explained that the set would have to come out of the cabinet for these to be fixed. When confronted with the condition he admitted that this had proved rather inconvenient, but it seemed that he hadn't considered it worthwhile mentioning. Apparently it wouldn't have worried him particularly if I had overlooked the point.

Just how the controls came to be in this condition was not perfectly clear. Each was fitted with the usual lock washer and there was plenty of evidence that the nuts had been well tightened when the set was assembled.



"Can you see the picture OK?"

It seemed fairly obvious that they must have been treated pretty roughly, particularly as all three were involved.

I had my suspicions about three precocious "little darlings" who had been standing nearby while I was working. They looked the type who could easily wreck the whole household if left alone for ten minutes, and I shuddered at the thought of a TV set being left in their tender care. Although it was not my place to say anything, their father seemed to read my thoughts.

"I don't think the kids could have done that," he said. "We never allow them even to touch the controls. It must have been the way the set was made."

I sneaked another look at the trio watching me suspiciously from the other side of the room. It wasn't hard to imagine any one of them sitting close up to the screen (as youngsters seem to do) and twiddling, pushing, pulling and otherwise manhandling the controls as a means of livening up an otherwise boring program.

Still, why should I worry?

With the controls righted again and the vertical stage performing normally, the job looked to be complete. However, something that Mrs Serviceman would doubtless describe as intuition, prompted me to make another check on the vertical deflection circuit. In particular I was intrigued by the owner's original statement that he had cured the "jumping up and down" condition by hitting the back of the chassis.

While this might have done nothing more than temporarily cure the fault that apparently was developing in the 6CM7, it also could have been a completely separate fault, dormant at the moment, but ready to show itself again at any time.

Since the chassis was out of the cabinet anyway, it seemed worthwhile to spend a few more minutes checking this point. I started by giving the rear of the chassis a sharp blow with my closed fist. I was rewarded by a slight, momentary reduction in picture height.

Turning the chassis over I located the component strip associated with the 6CM7 and prodded it with a screwdriver. This brought immediate and definite results, the picture dropping to about two-thirds its normal height every time I prodded the strip.

Next came the task of trying to track down the particular component or joint responsible. I went over the strip again, tapping and pressing gently in an effort to narrow down the area involved. This was not particularly successful, since it appeared that distortion of the panel at any point produced virtually the same result.

The more I prodded at the thing the more convinced I became that it was a dry joint somewhere on the strip. Tapping individual components seemed to have little effect, except when there was sufficient force to allow the shock to be transmitted to the panel.

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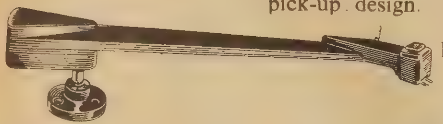

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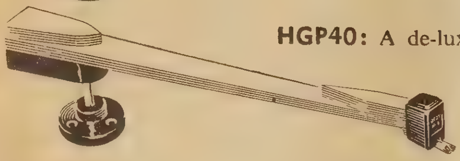

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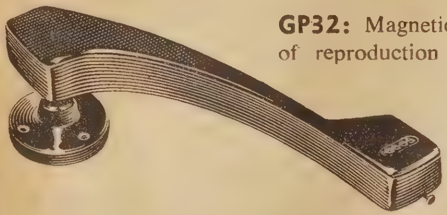

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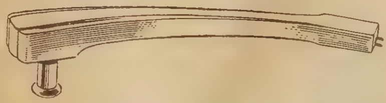

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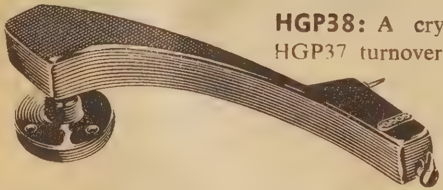

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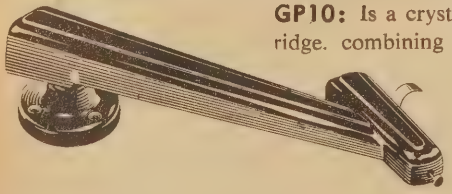

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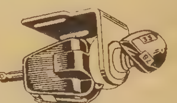

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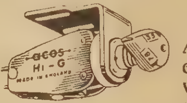

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I went over the whole panel again, examined each joint minutely, yet was unable to find anything even remotely resembling a dry joint. I had no doubt that I could find it given enough time, but it would mean taking the set back to the shop, and pulling the strip out of the chassis for a thorough overhaul. This would be a costly business, but it might be the only way if all else failed.

First, however, I meant to try a simpler approach. Plugging in the iron, I fished a tin of paste flux out of the tool kit and proceeded to apply this very sparingly to each joint on the strip. Then, when the iron was really hot, I attacked each joint in turn, feeding a little extra activated cored solder to it as the old solder melted. Finally, I wiped each joint over with a metho-soaked cloth to remove any surplus flux.

CURED

When I switched on and prodded the strip again the fault had vanished completely, and no amount of pounding, many times more violent than before, showed the slightest sign of it. Feeling that there was little doubt that the trouble was fixed, I fitted the set back in the cabinet, checked the operation of the controls once more, and took my leave.

Although I am a keen advocate of the idea that an intermittent normally should be positively identified before it can be regarded as cured, I feel that this was a justifiable exception.

The main reason supporting this was the fact that the effects of the fault were immediately and consistently obvious. Thus, unlike the intermittent which disappears for weeks on end, I could be reasonably sure that so long as it was present, I could make it misbehave.

Armed with this knowledge, the "blanket" remaking of the possible joints was a worthwhile try. If I was on the wrong track, the fault would remain in evidence and there would be no harm done. On the other hand, if it fixed the trouble—as it did—the saving in cost would be well worthwhile.

Of course, I would be denied the satisfaction of knowing exactly which joint was at fault, but that was of little real importance. Of more immediate interest was the question of how such a joint could escape detection.

I have seen some very tricky dry joints in my time; joints which almost defied detection even when the circuit involved was known precisely. Very often the fact that the joint has been made mechanically strong by twisting the lead, helps to disguise this condition.

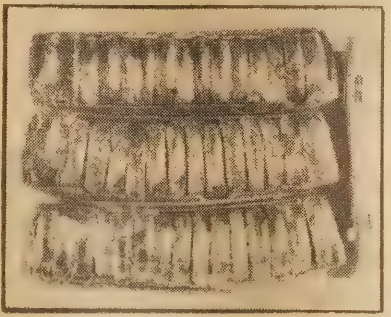
HIDDEN COMPONENT

Something like this may have happened in this case, particularly as a number of components were mounted underneath the panel as well as on top. The culprit could easily have been a pigtail from a hidden component, entering the underside of a joint which looked perfect from above and, superficially, from below. Even with a dental mirror it was impossible to see the underside of many of the joints properly.

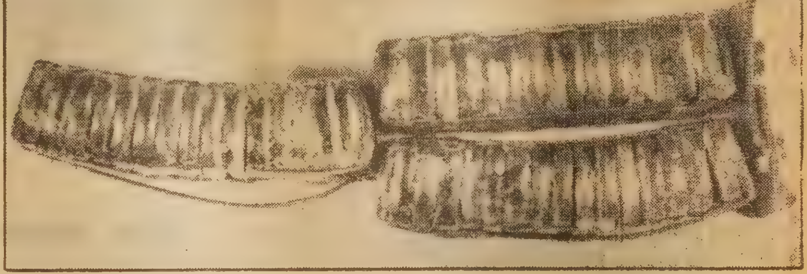
All of which is pure speculation, of course, but the important point is that the trouble was cured with a minimum of trouble and expense. A routine check some weeks later confirmed that there had been no recurrence of the trouble.

Another brief story about a TV set concerns an error that was more human than technical. The set concerned was a home-made job (apparently one of the "Radio, Television and Hobbies" designs), but I was unable to discover exactly how much of it had been made by the owner, and how much by someone else.

The owner was obviously the type of person who should never have undertaken such a project. His knowledge of basic principles was almost nil, while he seemed to have little or no practical experience, even in radio.



Although I was unable to photograph the original doctored battery, I was able to "mock up" the same thing later on from a discarded battery. Above are the three stacks as in the original carton.



In this picture the centre stack has been folded over to the left, the cardboard terminal board cut, and two outside stacks brought together. No connections have to be broken for this operation. (Curvature of the stacks is caused by internal stresses due to chemical action)

It seems most probable that he commenced the job himself, realised he had taken on too much, and called in someone to help him.

When he approached me his complaint was "a lot of funny lines across the screen." And, try as I might, I was unable to get anything much more out of him than that. I did establish that the trouble only occurred at odd times, but the description of the fault remained simply as "funny lines."

Feeling that it was probably a local interference fault of some kind, I decided to check the set in his home. At first there was no sign of the fault, and I imagined I had drawn a blank. However, while making a routine check of the general performance I switched to another channel, whereupon the horizontal synch dropped out and the picture disintegrated into a series of diagonal lines.

"There, that's it," exclaimed the owner. "It's always doing that."

I pointed out that this fault was probably nothing that could not be fixed with a half-turn of the Horizontal Hold control, but this was greeted with a blank look. And when I pointed to the said control his reply really rocked me.

"Oh, is that what it is. I thought it was to shift the picture from side to side."

Further investigation revealed the whole intriguing story. It seemed that our friend had only the vaguest idea of the function of the centering magnet, and had very little success in centering the picture by this means.

But he had discovered that one of the panel controls (Horizontal Hold) performed this function very well, so there seemed no need for him to worry further. What he did not appreciate was the fact that any good automatic frequency control system will allow a considerable change in control setting, with a shift in picture due to phase change, before synch is lost.

However, the fact that the picture continues to hold does not mean that the setting is necessarily right. In fact, it might be right on the verge of dropping out, and will drop out as soon as a disturbance, such as changing channels, occurs. Sometimes it will refuse to lock in again but, more often, it will lock in eventually. This was the situation in this case.

It took me only a few minutes to set the control for positive locking under all conditions, and then to adjust the centering magnet to remove the black blanking bar which appeared on the right-hand side of the screen. The result was another happy customer, but I'm sure he had only the vaguest idea as to what it was all about.

My next story concerns a battery mains portable and a rather unusual problem associated with it. In fact, there was nothing wrong with the set at all other than a set of flat batteries—but what trouble and strife they caused.

It all started when a sweet young thing walked into the shop, placed an attractive portable set on the counter and almost pleaded:

"Would YOU have a battery to fit this set?"

(As I discovered later, I was about the umpteenth place she had tried in the past few days, and she had virtually given up hope.)

Maybe I'm more susceptible to the charms of a lady in distress than the other fellows she had approached, but I made up my mind right then that I'd produce a battery for her set, even if I had to call in Mandrake to assist me. (As it turned out, I very nearly did!)

Fortunately I didn't commit myself

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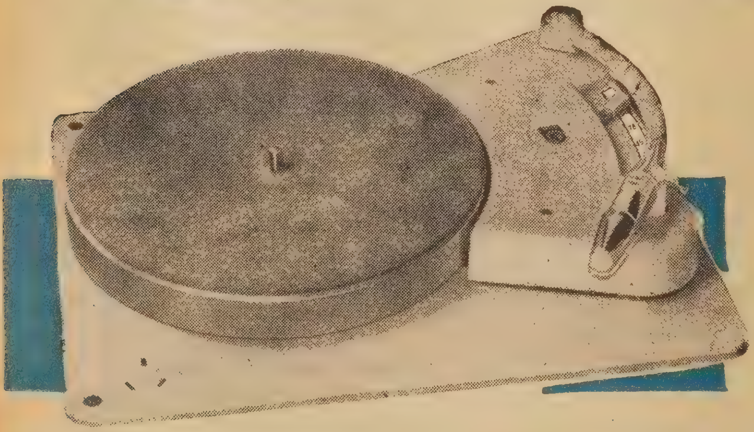

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quite so definitely out loud because, when I took a closer look at the set, I realised why everyone had shied clear of it. It was an American set, by a very well-known maker, and a beautifully made set, at that. The only snag was that it used a HT battery like nothing I had ever seen before.

It was a 90 volt type, made from a single stack of flat cells and intended to fit into a long, narrow compartment at the back of the set. In more precise terms it was about eight inches long and one inch square. As I said, it was unlike anything I had seen on the local market, and I told the owner as much.

THE STORY

That seemed to be her cue to pour out the whole sad story. It seemed that the set was a present from her boy friend who had recently returned from a trip overseas. Intrigued by this set while in the U.S., and anxious to bring back something not readily available in this country, he had regarded it as an ideal present.

I imagine it had been, too — at first. Unfortunately he had overlooked two important points. One was the availability — or otherwise — of the aforesaid battery, and the other the fact that the mains power supply was naturally designed for 115 volt operation.

Thus, as the set stood at the moment it was just so much useless junk, incapable of being used on either mains or batteries. Fortunately, whatever ultimately transpired about the battery, I felt reasonably confident something could be done about the mains operation.

I commenced to explain about the possibility of using a small transformer or resistor to provide the required 115 volts, but I could see that the idea was not making much impression. It seemed that someone else already had suggested a transformer, but the price had seemed out of all proportion to the value of the set. While transformers are not cheap devices, I had to admit the figure she quoted me did seem pretty steep.

"Suppose you leave it with me for a few days," I suggested. "I'll check up on the possibility of using a resistor or obtaining a more suitable transformer, and see what can be done about a battery at the same time."

MAINS FIRST

Grateful to have found someone who was even willing to try to solve the problems, the owner willingly agreed.

I decided to concentrate on the mains operation first. At first I was inclined to the resistor idea as being simpler and cheaper but, after a little thought, I realised that the idea was not as attractive as it appeared.

The set was a "transformerless" design, so that, whatever was done, the safety of the user had to be carefully considered. Unless one can be perfectly sure that nothing is ever going to break down within such a set, or that it will never be used with a broken cabinet or missing knob — plus a whole range of other possibilities which never occur to anyone until it is too late — a resistor is always a more risky proposition than a transformer.

What is more, the saving in cost would not be as great as might be imagined. A resistor would have to be housed in a suitable metal box, properly ventilated, and securely mounted to ensure that the box could not become "alive" in any circumstances. In all probability, the box would have to be made to special order, involving a considerable amount of time to work out the design, arrange to have it made, and finally fit it up. The cost could easily approach that of a transformer.

This, plus the safety angle, won the day in favour of the transformer. Fortunately, there was a small spec. plate on the back of the chassis, giving, among other things, the power consumption as 15 watts. I had an idea that one reason why the previous quotes for a transformer had been so high was because no one had bothered to find out just what size unit would be required, and had probably quoted for something more suitable for use with a 16 mm projector.

Next, I rang a transformer manufacturer and put the problem to the chief salesman. In a matter of minutes he had checked through the stock models available and come to light with a design rated at 25 watts. It was light enough and compact enough for anyone to carry around, and the price was quite reasonable. I placed an order without more delay.

(If there is any moral to this part of the story, it is to the effect that one usually saves a lot of time, energy, and mental stress by passing such problems over to someone far better equipped to deal with them than oneself. In fact, to the person who specialises in them.)

THE BATTERY

Thus, encouraged, I turned to the battery problem. I had a strong feeling that no such battery existed in this country, but I had to be sure. This time I contacted one of the major battery manufacturers, described the battery, and asked if they made it or anything approximately like it.

They were most co-operative and assured me that they knew the battery well enough (it seemed that others had been caught in a similar predicament) but were unable to offer much help. No Australian set manufacturer used such a battery and, in fact, that particular size cell was not even made in this country.

They suggested that it might be possible to "mock up" a 90-volt battery of some kind that would fit in the available space, but the life would be very much less than that of a proper battery, while the cost of making "one off" would be prohibitive. In the circumstances they could only point out how unwise the person concerned had been in not clarifying this point before buying the set.

I thoroughly agreed, of course, but that didn't help produce a battery. As I hung up I realised that I was on my own in this one.

I took down a standard 90-volt battery from the shelf and held it up against the battery compartment, trying to visualise a way to rearrange the four stacks of cells to fit in the available space. The idea looked sufficiently promising to justify breaking open a discarded battery and trying it out, the scheme being to make the battery into two sets of two stacks. Each set would consist of two stacks one above the other, and each set would be end to end.

At first I thought it might just fit. The compartment was quite long enough and for part of its length it was high enough, being actually higher than strictly necessary for the original battery. Unfortunately, the other section was just too small by a tantalising amount, and no amount of fiddling would allow both stacks to be accommodated.

INSPIRATION

But the set-up did give me an idea. One of these stacks could be fitted, making three (67.5 volts) in all, and this might be an acceptable arrangement.

Connecting the set first to a 90-volt battery and then a 67.5, I compared results. On 90 volts it performed extremely well, having excellent sensitivity, selectivity, and all-round performance. On the reduced voltage the change in sensitivity was barely noticeable, but some drop in power output was fairly obvious.

At the same time results were still extremely good, and I doubt whether a non-technical person would have been aware of the change. Of course, the end-of-life figure for the batteries would be less favourable, but this would be offset to some extent by the reduced current drain and longer life resulting

(Continued on Page 123)

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Let's Buy An Argument

Last month, I had a few words to say about the impossibility of knowing even a little about everything that in some way concerns us; about the ease with which any one of us can be deluded, seriously or in jest, about subjects which we have not had time to investigate; about the vulnerability of technical writers in this respect.

by Neville Williams

I KNOW this doesn't have any immediate bearing on radio, as it pertains to Ohm's Law or some mundane how-to-build-it project.

But what's the odds?

What's wrong, as I've said before, with having a little mental meander in nearby meadows? It's a welcome change from mere resistors and capacitors.

THE ELUSIVE TRUTH

At first glance, the lot of a technical writer, serving the man in the street, is not too difficult. Knowing that he has to discourse on a particular subject, all he has to do, seemingly, is to locate appropriate textbooks written by experts on the subject and re-present as much of the information as desired in easily readable form.

If he makes a mistake, then surely he has been careless?

But have you ever decided to delve into almost any subject seeking the "truth"?

So often, you just seem to be getting things sorted out when dissatisfaction emerges over a particular point; or you may discover some controversy about it. In short order, you are suddenly faced with a whole new aspect or a whole new set of opinions which vary from or contradict those you were about to accept.

The deeper you go, the worse it gets.

In case you think I'm exaggerating, have you ever pursued the homely but rather vital question of whether your child's tonsils or adenoids or appendix should be removed when complications arise?

"Most certainly they should," say many doctors.

"Hang on to them at all costs," say others having a different approach to the matter.

You, as a parent, have to make a decision one way or the other without really knowing the ultimate truth.

Again, have you ever tried to reconcile opinions about a good deal of modern painting and sculpture?

"Subtle, provoking, exploratory . . ." says one person.

"Puerile, inexpert work," says another who is seemingly no less of an expert.

And, back in our own field, how many arguments have we heard about the merits of different types of loudspeaker, methods of baffling, amplifier circuits and so on — between people who can individually boast a lot of experience in the field?

DIVISION OF THOUGHT

Nor can much of it be proved in the ultimate, because there is no agreement that instrument tests can duplicate the subjective reaction of listeners to loudspeakers, baffles, amplifiers and so on.

Such division of thought is baffling enough to a person who is just casually interested, but it is a real problem for a writer charged with the job of interpreting the subject in a popular article. Once printed, the article is irrevocable, and, in large degree, the writer's reputation rests upon its accuracy.

He may do one of three things:

(1) Play safe and present the "accepted" viewpoint on the particular subject—probably the one which predominates in current textbooks and currently taught in colleges and universities.

(2) Adopt a "centre of the road" approach, presenting the "accepted" theory, but then giving so much prominence to counter-opinions that the reader is left in a neutral kind of state, aware of different theories but assured of none.

(3) Become so absorbed in a subject that he studies it to the limit of his time and capacity. He gradually veers to one opinion or another, writes an article in appropriate terms and, in fact, finds himself virtually one of the "experts who disagree."

SEVERAL APPROACHES

Approach (1) is the most usual and it can be very helpful also, if the writer has the knack of expressing ideas in a logical, easy-to-follow fashion. He rejoices in the knowledge that, if ultimately he is proved wrong, he has plenty of company.

Approach (2) can be very helpful in creating an "awareness" of conflicting ideas in controversial subjects. But to avoid unnecessary confusion, it is highly desirable that the writer have enough background and discernment to perceive the main flow of opinion and, among the dissentients, to recognise those who could be genii, but are more probably "ratbags."

As for approach (3) it can be a rather uneconomical one for professional writers. It is so easy to read and study more and more about less and less until finally one can produce voluminous articles about a subject so specialised that the Editor won't print it!

Why? Because he knows that the readers wouldn't read it.

But why have "popular" technical writers?

A good question, with at least two good answers:

TWO GOOD ANSWERS

In the first place, a specialist in a particular subject, an "ultimate authority" is seldom the man to prepare a "popular," readable article. He is often too preoccupied, he may want too much money for too few words; he may not be able to divest his thinking of all the familiar side-issues in order to present what will appeal to a layman as "readable" article.

There is an old saying, I believe, about not being able to see the wood for the trees.

The second reason is that a significant proportion of the civilised races—particularly we menfolk, ahem — have a genuine desire to appreciate what is going on round us in the world of science and learning.

Who would have it otherwise?

Since it isn't possible to study all subjects from original sources, the only alternative is to rely heavily on "popular" technical books, magazines and articles to communicate the main trends of thought.

In this way our leisure time can be made educative rather than dissipative.

In "Radio, Television and Hobbies" we tend to specialise in matters electronic, but that word "specialise" is fast becoming a very hollow one.

In living memory it wasn't very difficult once to "know all about radio" . . . a spot of chemistry to do with batteries, some basic ideas about electrons and their behaviour, a knowledge of circuit practice and component manufacture, a grasp of propagation and what happened in a transmitting station . . . and you had "arrived."

But what a fantastic penetration "radio" has made into almost every phase of modern life.

THE SPECIALIST

While still tracing a clear lineage back to "radio" you can be a specialist in industrial electronics, racetrack totalisators, medico-electronics, computers, navigation aids, communication, propagation, audio, broadcast transmission, television transmission, sound receivers, television receivers — just to mention those subjects which come immediately to mind as I type.

Men are currently devoting their whole lives to one of these individual subjects or a section of one of them.

It is no longer possible to specialise in "radio."

All this might well seem like a lead-up to a confession that I, as a technical writer, have made a bad blue in print, and want to excuse it.

SOURCE OF EARTH'S MAGNETISM

Dear Sir,

I read Calvin Walter's interesting review of scientific hypothesis under the heading of "The Source of the Earth's magnetism" (Dec. issue 1958), but the "explanation" of Earth curents seem too much like delving into the realms of fantasy.

I suggest, contrary to scientific opinion, that the elusive "dynamo" which perpetually generates terrestrial magnetism IS outside the Earth, and periodically on view for all ultimately to see.

My personal hypothesis is that the mutual electrostatic field, set up between the Moon and our upper atmosphere, results in an electrostatic charge being perpetually rotated around and around the Earth and the resultant induced displacement curents flow along the ionised upper layers of the atmosphere. And incidentally what local effects this might have on radio transmissions I do not as yet know.

Stated another way, the initial or primary magnetising curents are not inside the Earth to be short circuited out, but outside and away from the Earth in the ionised upper layers of the atmosphere and in the appropriate direction for their magnetic effects to be perpetually felt inside.

There are varying degrees of ionisation, magnetisation, and hysteresis, as well as the build up, decay, and even reversal, in induced secondary Earth-currents which would also vary with conductivity.

Add to these the effect of the Earth's wobbly axis which results in perpetual changes in the angular direction of magnetisation, and shift of the magnetic poles, and all the ingredients are provided to produce a pattern of the Earth's "lines of equal magnetic intensity" which is anything but symmetrical or constant.

Polar orientations may be proved correct by employing the "Right hand Rule" for generating magnetic fields. The "Cork-screw" rule gives similar results.

And finally since the magnetisation of any planet appears to depend first on its having a suitable ionised atmosphere plus one or more moons or their equivalent, the planet "Mars" and our "Moon" would each be expected to exhibit no strong magnetic field.

Kind regards.

S.V.H.

Fortunately, there is no such motive. If I have made a "blue," it has either passed unnoticed or I've managed to wriggle out of it, one way or another.

No, in point of fact, the mood was brought on by remarks already referred to, made last month, by the letter on this page over the initials S.V.H. and by an article on "Light for the Blind," reprinted elsewhere in the issue.

My confrere Phil Watson came across this article and opined that it should be reprinted in our Review section, because it was of such potential interest. I read it and agreed.

MEDICO-ELECTRONICS

It is written by a qualified medical practitioner, who apparently has more than the usual medico's knowledge of matters electronic. He is obviously highly enthusiastic about the whole scheme and the style of the article is more graphic than sober.

But what does it mean medically? Does Dr Button's work really break new ground or is a mere mechanical demonstration of what others knew would happen anyway?

Were his results attended by a good deal of luck and is a practical application of his experiment out of the question? And what of his expectation of greater things, the ability to perceive light patterns?

Some may support his optimism, others may deny it — but is either reaction based on experimental knowledge or is it merely intuitive?

Since none of our staff, or, I imagine, the staff of "Radio-Electronics," is inclined to embark upon "A Short Course in Brain Waves," we can merely regard the article as highly interesting, accept the author on his medical standing and publish his findings.

Any arguments?

Then there is this letter by S.V.H.

Upon receipt, I turned back to Cal Walter's article and read it over again.

Now Cal is a "popular" science writer in both senses of the word. Unless I am mistaken, he has had an article in every single issue of this magazine since its inception in April, 1939.

He isn't an expert in every subject on which he writers, but he had early technical training and is an inveterate reader of scientific books and magazines. In his articles he writes of things which he has enjoyed reading about. To judge by their remarks, our subscribers appreciate his efforts.

On this basis, his dissertation on the source of the earth's magnetism reflects what are currently accepted ideas. Though interspersed with a good many "ifs" and "buts," they are widely held and there is a good chance of their being correct in the main.

But along comes our correspondent S.V.H. and flatly contradicts the whole concept, substituting an entirely different one.

IS HE RIGHT?

Now I don't know how much of an authority S.V.H. is on these matters, but I do know him as a radio pioneer, with a good deal of experience in the broadcasting field. Has his preoccupation with the ether left him with a prejudice that way or is there sound basis in his reasoning?

Maybe somebody else would like to argue the point with him.

To get back on to more conventional ground, those of you who do not regularly see "Wireless World" may be interested in a letter written to the Editor

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GP 73-1C	"	1 diamond, 1 sapphire stylus	11 18 6
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of the aforesaid journal by G. A. Briggs, author of a recent series of articles in "R., TV and H."

The letter is both sobering and interesting, written, as it is, by someone recognised as a world authority on audio matters. (It was written some months ago.—Ed.) Whether you—or I—agree with everything in it, Briggs' opinions are well worth hearing.

While most of our own work on stereo has been done personally by the Editor, John Moyle, I have stood on the sidelines a good deal and have registered certain reactions to the whole thing. I summarise them as follows, for what interest they may hold:

1. Having seemingly rejected domestic tape systems and exhausted the immediate potential of conventional discs, the entire audio fraternity was ripe for some new development. Stereo became that development and, from the moment its potential was proved, there was a clamour for information and then for the system itself.

2. Stereo has a vital contribution to make to audio reproduction. Its impact goes much deeper than "gimmick" sound effects. While admitting certain limitations of any two-channel system, I, nevertheless, experience the feeling, when listening to it, that my two ears have something once again to work on.

NEW STANDARDS

3. There seems to be definite subjective relationship between the stereo effect and our concepts of volume, frequency response and distortion, based on single-channel systems. I have observed people quite happy with stereo at a much lower level than they would normally use for a single channel. Conversely, I recently noted someone sitting equally happy through a multi-channel tape-recorded performance at very loud volume; that same person has normally been extremely intolerant of even moderate volume from a conventional hi-fi system.

4. The two-channel gramophone record is successful in itself, though its production may require a tightening of standards in regard to processing. Stereo records can be extremely good and on a par with conventional records.

5. Currently, the tough problem in the stereo system is the pickup itself. Variations in crystal behaviour which pass unnoticed in a monaural channel may cause noticeable drift between nominally balanced channels. At the other end of the scale, some of the very high quality magnetic pickups haven't been above reproach. The "medium-fi" ceramic approach seems to hold the advantage meantime and it can sound mighty impressive, definitions notwithstanding.

HERE TO STOP

6. Stereo is here to stay and will find plenty of support at every audio level, from high fidelity through to the stereo-cocktail-bar-grams. How it will share the market with monaural on a percentage basis, I don't know. Neither does anyone else.

7. The present bickerings about release dates, including Briggs' observations, are to my mind not significant. It's the familiar chicken-or-the-egg problem all over again and will soon be forgotten. In this commercial world, organisation isn't good enough to ensure simultaneous release of an ultimate, fully-engineered system. On that basis it would never be released. The strongest and, in some cases the only, incentive to improve a product is the knowledge that you will "go broke" if you don't. Even if all stereo release dates had been put on six months we would be still hearing the same cry.

STEREO IN PERSPECTIVE—BRIGGS

It is about three years since you quoted me in your columns as having said that the success of the push-pull electrostatic speaker would depend, not on perfection but on facility and cost of manufacture, and versatility and reliability in use. The moving coil still seems to reign supreme. I wonder if I may issue a similar warning about stereo?

The trouble with stereo is that it was launched on the public six months too soon; too many fantastic claims have been made about it; and beautiful, hand-made, precision-instrument-type magnetic pickups have been demonstrated, and eulogised in the Press, before production runs and life tests have been made, and before supplies are available to the public.

The result is that dealers and would-be buyers are being driven round the bend with an uncertain and obscure vista before them when they reach the straight.

We noticed the red light at the Audio Fair in April, 1958, when we found that, after carefully balancing our two channels before the show commenced, the output from each side varied by as much as 6dB when the room was full of people, and temperature and humidity went up. (Any talk about "matched" speakers under such conditions is absolute piffle.)

More red lights appeared in the Audio Hall during the recent Radio Show, when one firm informed me that six stereo pickups had packed up in their hot demonstration room during the first few days.

Then, only last week, a well-known maker of magnetic pickups informed me that his commercial stereo pickup will be a ceramic type. If this is not a red light I must be colour blind.

After paying higher prices for superior performance from magnetic pickups during many years, are we to lower our standards for stereo; or pretend that the same standards do not apply; or just admit meekly that we were wrong?

We are told that stereo pick-ups can be used with safety on ordinary discs, but the voltage output is much lower, and the quality of reproduction—type for type—on single channel is definitely inferior, with the magnetic and crystal types we have so far tested.

The basic fact is that a wide-response stereo pickup is more delicate and complicated than a mono type, and its expectation of a trouble-free life is correspondingly lower.

As things are, it would be extremely foolish to discard our high-class single-channel pickups, amplifiers and loudspeakers in favour of a stereo system, and the high quality of thousands of existing records must still be recognised.

Stereo should be accepted as a possible extra channel to give us greater realism when it comes off; so far it often misses the mark, and it is certainly much more difficult than single channel to get right and keep right. The change to stereo can then be a gradual process instead of a jump.

First-class single-channel results will always surpass second-rate stereo, and we don't want to hear any more trains.

As regards loudspeakers, one good one and one mediocre one sound better than two mediocre ones, whether on stereo or single-channel input. This is just a law of nature, which no fiddle-faddle with recording can alter.

G. A. BRIGGS,
Wharfedale Wireless Works, Ltd.
Idle, Bradford, Yorks.

ONE AND A HALF CHANNELS?

Dear Sir,

My argument is not with you so much as with Mr Moyle, but it may be suitable for your pages.

In the July issue, on page 32, Mr Moyle states that, "for good stereo reproduction, each channel should be capable of handling virtually all the programme. If it takes so many watts to adequately reproduce a trumpet or a bass, then we must be ready for it, no matter what channel it comes through."

Is this so?

From various literature, it would appear that the stereo effect is concentrated in the range of frequencies from about 300cps to 6 or 7 Kc.

If use is made of this effect, then the cost of stereo equipment can be reduced considerably (one of the points in Mr Moyle's article).

Feed all of channel 1 into a wide range system. Feed channel 2 into the same system but feed from 300cps up into a separate channel system.

The channel 1 system, apart from some coupling of controls with channel 2, will not alter much from the present monaural set-up.

The channel 2 system can be much cheaper. It does not have to handle the power of the bass and it needs no low frequency speaker.

If the tweeter is adequately diffusing the highs on channel 1, it is quite possible that the channel 2 speaker need reproduce only 8-10 Kc.

As Mr Moyle said, friend George will definitely want to avoid doubling up on his present set-up and this is surely the way.

Yours faithfully, G.L.

Still on the subject of stereo, a reader asks some pertinent questions about saving cost in stereo systems.

I would say that his ideas are quite feasible and could probably be executed to give a very acceptable result. But they may not find much support in practice.

While some may use such a system initially to avoid too much extra expense the urge will be there all the time to install a pair of completely balanced channels. I'm afraid an urge of this kind

(Continued on Page 127)

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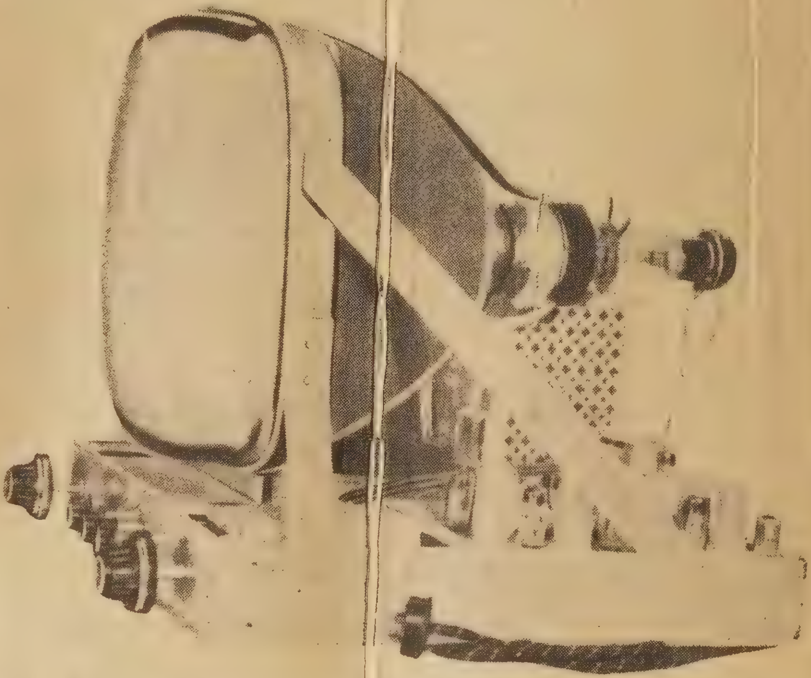

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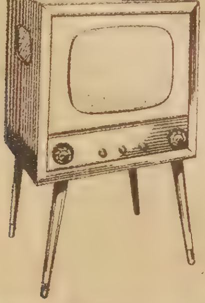

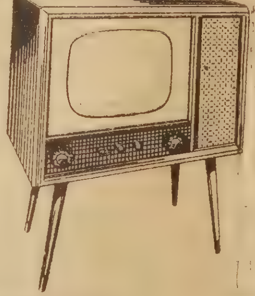

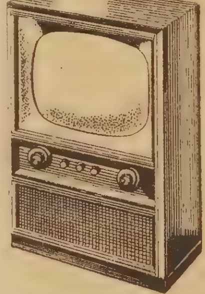

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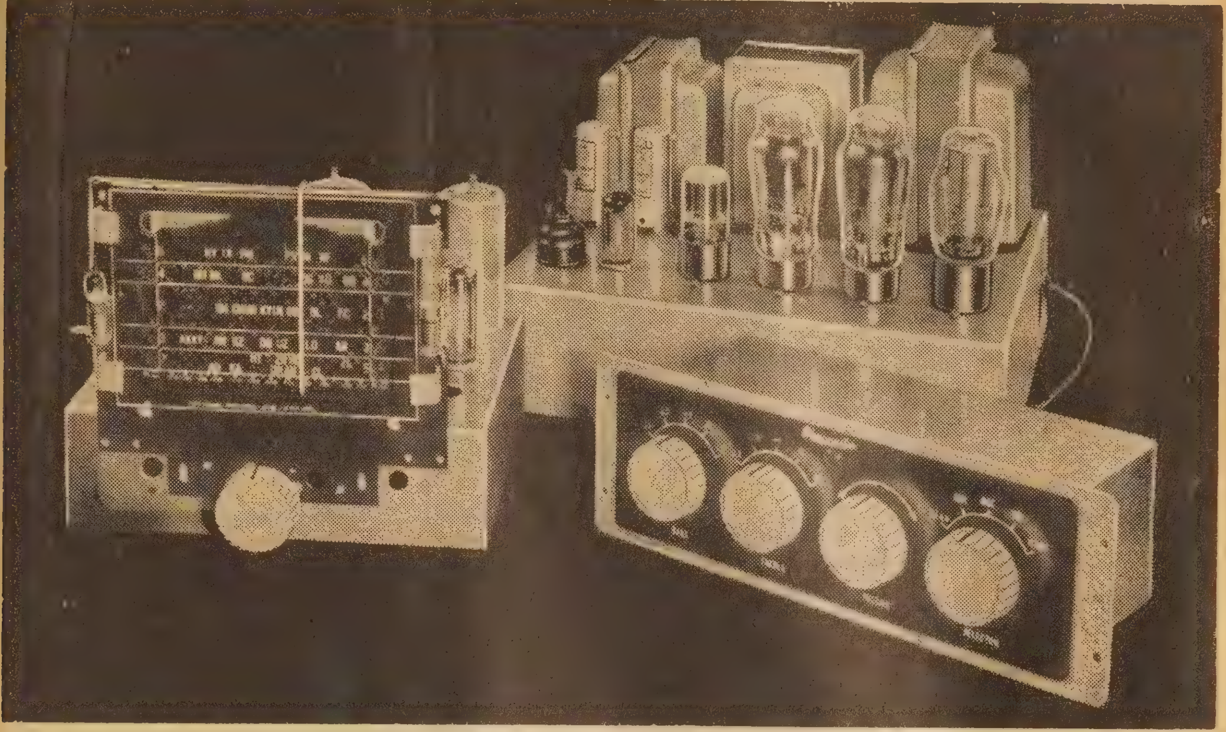

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STEREO AMPLIFIER

Interest is growing rapidly in stereophonic sound and we are happy to announce that kits or completely built units are now available for the STEREOPHONIC AMPLIFIER designed by John Moyle ("Radio, Television and Hobbies," July, 1958) STEREOCRYSTAL CONTROL UNIT ("Radio Television and Hobbies," October 1958) and STEREO PICK-UPS and CARTRIDGES ALSO AVAILABLE. Send coupon for price and all details on items required.

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OFF THE RECORD — NEWS & REVIEWS

A problem which is exercising the minds of many engineers and technicians at the moment is how to obtain good stereo effects as simply and cheaply as possible. In the commercial world, this is naturally a most important point.

by John Moyle

IN tackling it, they have gone to considerable trouble to analyse the operation of stereo—what is the main cause of apparent directivity and so on.

It is generally conceded that the extreme bass end is not nearly as important in placing the source of sound as the middle and high registers.

Some maintain that it is really the transients which do most of the work, and have carried out many experiments with restricted band amplifiers to demonstrate the point.

All this is to the good. As with any other subject, we can make the most use of stereo the more we know about it.

Let me refer now to a correspondent quoted elsewhere in the issue who queries a statement of mine made in a previous article that good stereo required two channels capable of handling virtually all the program.

His point is that, if the stereo effect is largely wrapped up in portion of the range, it will surely be enough if the second channel does no more than cater for that range.

THE BEST STEREO

Maybe I should have specified originally "the best" stereo instead of merely "good" stereo. It seems fundamental to me that, if we have two channels, either one of which might at any time be called upon to handle any kind of sound just as it would have done as a single channel amplifier, we should require that its specifications should provide for it.

I think any arrangements which allow for a second channel which is not a duplicate of the first are just what they claim to be—methods of avoiding the original balanced pair in the hope of saving cost and/or complexity.

My experience in listening to stereo in a good-sized room and with well-positioned speakers is that, with the possible exception of the very lowest bass, virtually the full frequency range is appreciated as a function of stereo, so much so that I would want it that way.

It is highly probable that, if the same set-up had used one restricted channel, I would have still heard good stereo in that the presence of the second channel made a more or less useful contribution, but I do not think it would sound as good as with two identical channels and speakers.

COMPROMISES

Even the sharing of the powerful low frequencies between two amplifiers and speakers would surely be extremely beneficial in producing a wide wave-front and less distortion.

In a smaller room, and a less favourable set-up, where the fullest appreciation of the stereo effect would not be obtained in any case, some compromise on the lines indicated might be acceptable with a less noticeable result.

In fact, one of the advantages of stereo is that an improvement over single channel can be noticed even with simple equipment, but let no one persuade himself that it is as good as that from a first-class installation.

Under ideal conditions, results can be breathtaking, and quite a few of the difficulties and objections often met with are either greatly reduced or removed altogether.

For instance I have been impressed with the way the "hole in the middle" effect has been absent on some demonstrations I have given in city halls, as compared with the results obtained at home.

And to support the remarks of Neville Williams, the very bad effect noticed by using loud speakers with greatly varying colouration, particularly in the middle region.

RECORD REVIEWS

MY FAIR LADY.— Musical numbers by Rex Harrison, Julie Andrews, Stanley Holloway and original Broadway cast. Coronet KLL 1620.

Apart from the popularity of My Fair Lady overseas, there were other reasons why it should have done so well in Australia.

It has been tantalisingly waggled before the public for quite a time now, and each incident which made up the waggle heightened the interest.

Until its release date it was banned from broadcasting, and only a few discs were brought into the country and swapped about among the fortunate ones.

There was a legal passage involving Liberace who was very mad because he wasn't allowed to play its music when he was out here.

Even at D-day there was that newspaper report that Shaw hadn't really originated the play Pygmalion at all, but had filched the idea from a story sent to him by, of all people, a famous Australian writer of children's books.

This kind of publicity makes glad the heart of all record companies, and guarantees good results when at last they are ready to go.

And go they did. For the last few months we have had Fair Lady in more versions than one could conveniently count and they have all done well.

But none as well as Coronet's full, authentic and original recording by the Broadway cast, which has outsold them all.

By the time this is in print, I wouldn't be surprised if its sales have topped 100,000 copies with more to come.

And this is probably why it scarcely needs comment from me to tell you it must be good.

I haven't heard them all, but it's quite the best so far. Mainly because it's the original, I think. Some of the voices aren't endearing in themselves, but there's only one Julie Andrews and Stanley Holloway and somehow no one else sounds quite as good.

Technically it is well up to standard, although I don't think it is quite as bright as an American pressing I heard some time ago, but not many will worry about that.

For the Fair Lady fans, nothing else will do.

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A STEREO TEST RECORD FROM E.M.I.

STEREO DEMONSTRATION RECORD — Test Disc by EMI SDD1.

This was actually the first stereo disc I received for review, although I have several others which will undoubtedly be released here before very long.

Nearly every company has produced a demonstration disc, or sampler record, intended to introduce the listener to stereo, and to follow a small lecture on the subject with numerous examples of its own work.

I have found all of them good, and each has some department in which it outshines the others.

On one side of this record there is a collection of effects—a fire alarm at a London fire station (the first time I have heard recorded the sound of a man sliding down a greasy pole), swimming bath noises, Big Ben and traffic, some vivid express trains which rush through Hayes station, a very effective game of table tennis, some road drills and a blacksmith shoeing horses.

There is also an extract from a Tchaikowsky symphony, but it is on the other side that most of the serious sound is recorded.

And most effective are the operatic excerpts, from the Beggar's Opera and Falstaff.

These are a most convincing demonstration of the immeasurably added interest where numerous voices are concerned, each being set in its place, and the interplay of dialogue very greatly improved thereby.

In fact it is so good as to suggest a new life to this type of recorded entertainment.

The music contains more Tchaikowsky, Peer Gynt, and music of a more popular kind, ranging from big combinations to small.

These are all good, although the full orchestra is not quite up to the standard of some I have heard on other discs.

On the other hand, these have not done so well as EMI in other fields. There is also a metronome track, useful for balancing the channels.

I think records such as this will have a steady interest for quite a while as stereo comes to life. Everybody will want to show off their new players to friends and to themselves, and here on a single disc we have a cross-section of all the usual and unusual things stereo can do.

The surface noise is fairly good, although not quite up to the top standard, and on my copy the voice of the compere was not always completely clean. But this could be blamed to my stylus, which has now seen a good deal of wear on an endurance test.

Undoubtedly this will become one of the standard demonstration records.

DREAM TIME — Played by Wayne King and his Orchestra (Stereo). An Affair to Remember, Fascination, My Heart Reminds Me, Shadow Waltz, Man of a Thousand Years, Tammy, Around the World, Star Dust, Till, Dreamy Melody, Forgotten Dreams, Melodie D'Amour. Festival FST-1002.

The jacket note describes Wayne King as a musical sandman with a solid reputation for dreamy orchestration, and I think this is a very good assessment of what you will find on this disc.

It is quite understandable that the impact of stereo is most easily appreciated in dramatic music, in which the often startling effects of instrument separation and big sound are heard to very great advantage.

But further experience of listening will make you aware of the more subtle advantages it brings by the fusion of the two channels to provide a most telling sense of space and even of depth.

This is the angle which Wayne King has exploited, and he does it very well indeed.

His success is demonstrated very easily by playing the disc with two channels in parallel. It still sounds good, but the dimension is no longer there.

The separation of instruments, when it is present, is effective and unostentatious, and admirably in keeping with the title of the disc.

The original recording was made by American Decca, and as seems characteristic of these discs has a tendency to highlight the top register. This can, however be easily adjusted to taste by use of the tone control.

The bass is firm, and the overall balance smooth and easy on the ears. The surface, too, is extremely good, and at quiet room level, the most likely condition of listening, virtually inaudible.

Price of the disc is only 55/.

SMETANA—The Moldau; WEBER — Invitation to the Dance; LISZT—Mephisto Waltz; BERLIOZ — Dance of the Sylphs, Rakoczy March. Played by the Philadelphia Orchestra, conducted by Eugene Ormandy. Coronet KLC 2677.

Even for the Philadelphia, this is a brilliant disc.

As with many of its latest efforts, the bass response is lighter than in earlier days. It has a tighter and more remote quality and it goes with the airiness of the sound which indicates a concert hall at the back of it.

Its a good example of the undoctored acoustics which are a feature of the latest technique.

I'd be surprised if one day we don't hear these numbers in stereo.

Both the minuet and the Sylph Dance contain some beautiful controlled and delicate string playing, the greatest possible contrast with the long and involved orchestration of the Mephisto Waltz and the noisy exuberance of the March, one of the selections which helped to make the early fame of the orchestra.

The same is true of the Invitation to the Dance, which was even more popular about 30 years ago, a landmark in the catalogue in the initial era of electrical recording. I'm quite sure many readers still have it.

This new version immeasurably transcends that famous disc in every way, including the beautifully played cello passage in the introduction.

The Moldau, part of Smetana's most popular work, is particularly rich in colour and movement.

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The composer could not have wished for a more eloquent and smooth performance to portray the progress of the broad river, or a wilder confusion of waters dashing through the rapids and cataracts.

The recording is particularly clear and clean, but even with extra bass boost I thought it rather light in sound.

More at the bottom end would have improved balance.

The surface is extremely good, and the net rating very high.

* * *

TCHAIKOWSKY—Aurora's Wedding, from Sleeping Beauty; Black Swan Scene, from Swan Lake. Played by the Minneapolis Symphony Orchestra conducted by Antal Dorati. Mercury MG50118.

I have already reviewed the full-scale version of both these ballets which were sensations when first issued in 1954 and 1955.

At that time I gave them the highest commendation for their exceptional brilliance and high technical standard.

It is mere repetition, therefore, to go over the same ground.

Since then, recording technique has moved into a rather more spacious era, less brilliant but more reverberant.

But for sheer spectacular and vivid sound, few of them equal that of Mercury.

"Aurora's Wedding" is really a collection of selections from the complete work, and is the form in which most ballet companies present it today.

It was on the program when I visited La Scala two years ago, and I won't easily forget it.

The Black Swan Scene here included the Pas de deux (Act 1, No. 5), Pas d'action (Act 1, No. 6), and Scene—Pas de deux (Act 3, No. 24).

I can only rate the record in the same class as the original, and many will welcome it who can't acquire the two full sets.

* * *

FRANZ LEHAR.—The Merry Widow. Soloists and Orchestra, under the direction of Marcel Carivien. Philips P 77106 L.

Really splendid recording is the most obvious thing about this disc.

All the voices are clear and forward, the diction is good and the recording of them completely clean.

The orchestra helps them in this by its rather remote placement, which ensures that at all times it is an accompaniment and not a competitor. After all, that is its role.

In most of the music there is a pronounced bass line, and this has been strongly emphasised, again as it should be.

It is real bass, too, full and resonant, giving a most attractive body to a lively orchestra.

This is a studio performance. There is no atmosphere of movement or development, but Lehar's music is so beguiling and irresistible that it can speak for itself any time as far as I am concerned.

It is really a continuous selection of musical numbers, and as such the general balance and standard of performance is always first rate.

But there are many people who would like to identify items as they come along, and neither the record label nor the jacket notes help them in this.

It is almost impossible, too, to identify them by sides, as the clue to which is the first or the second is well hidden in a matrix number and appears nowhere else.

All available space is taken up by a list of the full cast, which also occupies half the sketchy jacket notes.

Naturally the French cast sings in its own language, but this makes it even more difficult for the average listener.

But there is no doubt that this is a delightful disc, with a beautifully quiet surface and outstanding engineering.

You will love it.

* * *

CHOPIN — Ballade No. 2 in F Major, Opus 38; Ballade No. 3 in A Flat Major, Opus 47. Played by Cor de Groot. Philips 400 041 AE.

Cor de Groot is a pianist who can play most things well, and some of them very well.

His Chopin is not of the imaginative, Polish kind. It is played with variety, often with vigour, and with a clear right hand, but it hasn't a great deal of fire and its romance is rather formal.

The piano recording is strong and forward in tone, although in the Second Ballade it sounds rather hard in the loud passages near the end, where the cutting amplitude is high.

But, on the whole, it is quite a nice disc, and economical as well.

* * *

BEETHOVEN—Concerto No. 2 in B Flat Major, Opus 19. Played by Wilhelm Kempff, with the Berlin Philharmonic Orchestra, conducted by Paul van Kempen. DGG LPE 17083.

Although numbered as the second, this was really Beethoven's first piano concerto, more like those of his distinguished predecessors than his later concertos, but unmistakably Beethoven for all that, clearly indicative of those to come.

Its issue completes the full set by Kempff, and all are in the preferred class in my opinion.

This one is most clearly articulated, partly because it is balanced that way and partly because the recording as such is very good in the classic DGG manner.

It is a satisfying manner, too, never over-brilliant or heavily weighted, always smoothly cut and with a conservative solidity that wears well.

Kempff's approach is primarily that of the old master school, although he has some individual habits which divide him from the strictly classical.

As always, some of his dynamics are unexpected, and this is a work which is generally allowed to take its own pace.

I thought the performance full of life and altogether refreshing.

I have heard this concerto played by numerous pianists, many of whom take it as an easy one because of its extreme simplicity and uncomplicated ideas. To Kempff, it is neither a subject for experiment nor strict orthodoxy; he has illuminated it in his fashion, which is distinguished if not brilliant.

The recording is admirable in every way, and I can safely recommend it, particularly to those who already have heard and liked the companion discs already issued.

SCOTTISH SPLENDOUR—Recital by the Regimental Band, Pipes and Drums of the Black Watch. RCA L10543.

This isn't a record for everybody, simply because everybody isn't in the market for two sides of band and pipe music.

Particularly pipe music.

It's a pity, because the conventional horror of the pipes has prevented many from appreciating a remarkable and unique instrument.

A full pipe band has the ability to stir the spirit in a manner not equalled by anything else. It can equally produce music of such haunting and delicate quality as to be almost overpowering.

This record is not wholly taken up by the pipes, but is fairly evenly divided between them and the military band, which Scotchmen aren't supposed to play.

And on at least one item—Scotland the Brave, of course—they join the pipes in a fine round of noise.

Unfortunately there is only one solo pipe playing Donald Blue, which stops as suddenly as it starts.

What a pity it wasn't MacCrimmon's Lament!

The recording has the quality of the open air, and although initially it sounds overweighted with top register, reflection will remind you that bands do not normally play in studios, except for broadcastings, and when they do, they lose the characteristic of their natural habitat.

The selections are too numerous to list here, but lovers of band music will know most of them, and they are all played with admirable precision and verve.

* * *

LISZT—Piano Concertos Nos. 1 and 2. Played by Alfred Brendel and the Pro Musica Symphony Orchestra, conducted by Michael Gielen. Vox APL 10,420.

Two months ago I reviewed a piano recording of Moussourgsky's "Pictures At An Exhibition," played by a pianist I had not heard before.

His name was Arthur Brendel, 27 years old and as brilliant as they come.

His performance on that occasion inspired me to an enthusiasm which grew in stature after hearing these two concertos.

They are really magnificent in both their conception and execution.

Both are big, brilliant and boisterous works, filled with lusty and romantic vitality, and requiring a pianist with enormous resources to do them justice.

They require a special kind of pianism. A high pressure technique alone won't do, for high colour and the romantic mood will sound empty and cheap. A good all-rounder struggling to cope with digital speed and general dynamics won't do either, for if this music is not handled with ease and power and authority it is nothing.

But the way both concertos are played here is something to get excited about, for Brendel has all the equipment to present them superbly.

Liszt himself could not have given a better performance.

We are certainly given every opportunity to hear the piano. It is not recorded at really close hand, but the level is always more than adequate, and the pianist's power is such that he is a match for any orchestra.

In this concert hall atmosphere the engineering has achieved a really good

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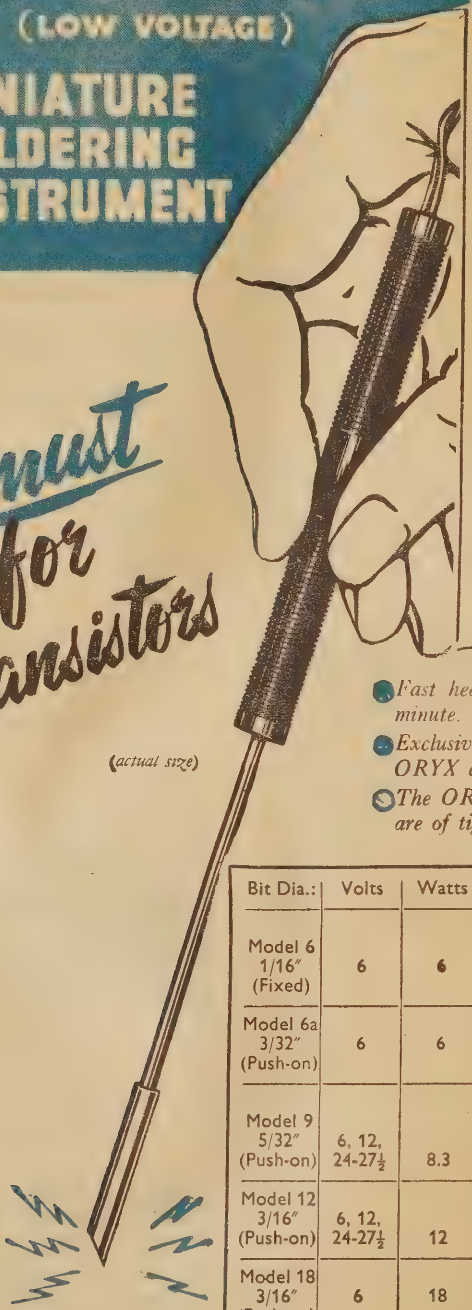

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Model 12 3/16″ (Push-on)	6, 12, 24-27½	12	0.5 oz.	6.25″	Radio, Television, and Telecommunications assemblies.
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MSP3.58

sense of balance, which does wonders for the piano tone and the huge chords which Brendel makes sound so massive.

I'd hate to face the problems of close miking with this man, as much as I'd hate to hear the result.

The orchestra goes along with the mood of vitality and breadth, although there are a few moments where the sound isn't quite as good as the splendid piano.

I seem to remember a spot where a really luscious cello would have sounded much better than the rather anaemic one I heard. But the whole thing is so good that such things are scarcely worth a mention, and at least not until a better version arrives.

There have been some fine recordings of these concertos issued in the past, and indeed some of them still sound good.

But if you add up the score for balance, virtuosity, sound quality, dynamic range and, above all, good surface, Vox have without doubt come up with the winner.

And, by the way, why didn't they identify the fine picture on the cover? Is it the Vienna Opera House? I wish I could tell you.

* * *

ITALIAN INTERLUDE — Ten popular and folk songs of Italy. Sung by Murray Dickie with Gianni Monese and Orchestra. Vox AVX-1440.

Quite a pleasant record, but as a note with a disc says, we hear a Scotchman singing Italian, and our ears tell us how right this comment really is.

Murray Dickie is undoubtedly a good tenor, and his regular appearances with world opera companies testified to the fact.

But Italian folk songs, and popular songs, lie strictly in the realm of genuine Italian voices, and these are poles apart from the English (or Scottish) types, despite all the effects of training and earnest endeavour.

Recording is good, and the music includes all the popular items.

* * *

BEETHOVEN—Concerto No. 5 in E flat major Opus 73 (Emperor); LISZT—Hungarian Rhapsody No. 3 in C sharp minor. Played by the Vienna Festival Orchestra conducted by Hans Swarowsky with Hans Kann as soloist. World Record Club TT10.

So many Emperors have gone to disc that it would require something really special to upset the status quo among the 15 or 20 versions which the earnest collector could commend without much difficulty.

And among them he could number just about every important orchestra and performer in the world.

Probably four or five of these could be lumped together as the pick of the bunch, according to inclination and taste. A very large number of those left could be classed as good average performances which can be heard with equal pleasure, and the remainder are best forgotten.

This record I'd place somewhere in the middle group, with a special note of its vigor and sincerity, but with an equally valid comment that, in my view, it misses out on many of the things which makes an Emperor memorable.

From first to last the concerto is

MELBOURNE'S NEW AUDIO CENTRE OPENED

Last month the latest showroom and sales centre for Audio and Stereophonic equipment was opened in Melbourne. Following the most up-to-date examples from overseas trends, this showroom provides all the equipment and facilities to demonstrate monoral and stereo hookups which will satisfy the most discriminating audiophite.

A full range of new and exciting sound equipment is on display, both stereo and Monoral, by "Leak" Astronic, Tandberg, Byer, Ortofon and many other world-famous manufacturers.

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This modern showroom is sponsored by Victorian Tele-Service at their premises in 783 Glenhuntly Road, Glenhuntly, where they have made a feature of after hours demonstrations. This venture was prompted by the fact that most enthusiasts find it difficult during business hours to arrange sufficient time to attend demonstrations and select equipment at their leisure; so now by phoning UL1038 or UL4501 after hours they can arrange a time to suit themselves, without any feeling of obligation.

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Quite a large range of extremely high-quality Stereophonic and Monoral recordings and pre-recorded tapes are in stock and further supplies from overseas are arriving in limited quantities.

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For those who are interested in the equipment mentioned in this article, it is suggested that further inquiries be made to Victorian Tele-Service Pty. Ltd., 783 Glenhuntly Road, Glenhuntly. UL1038.

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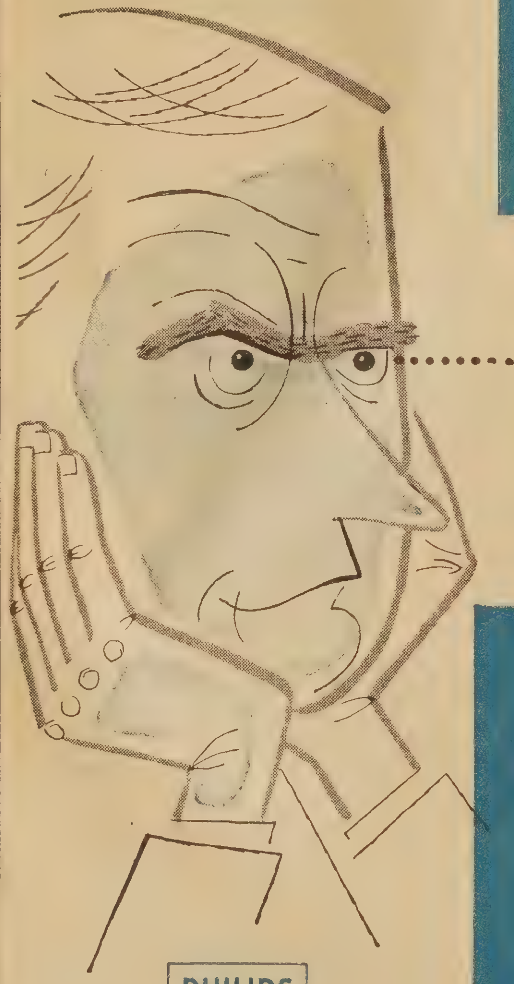

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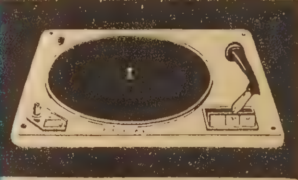

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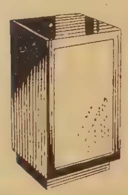

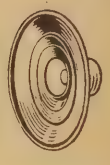

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rattled off at a great pace. I didn't time it, but I'd have a small wager that there is no other version which maintains its briskness with such consistency.

I've heard it played in various parts of the world probably more than any other concerto, and in more different disguises. If I had to choose between this kind of speed and the long drawn-out affairs which so often replace it, I'd unhesitatingly plump for the former.

But I can't see why orchestra and soloist, both competent performers, couldn't have relaxed with a little more penetration.

The recording sounds fairly good, but if you listen closely you will fault it on many counts of balance and lack of subtlety.

The same applies to the Liszt Rhapsody which might more appropriately have been replaced with a Beethoven Overture or some smaller work.

Surface is average only.

FRANZ LISZT — Hungarian Rhapsodies Nos. 6 and 15, Valse Impromptu, Consolation No. 3 in E major, Consolation No. 3 in D flat major, Rigoletto Paraphrase, La Campanella. Played by Tamas Vasary, pianist. DGG LPEM 19105.

Here is a very generous selection from the popular piano works of Liszt. It includes at least two of the show pieces which the more brilliant performers use to exhibit their ability.

Tamas Vasary may be young and a newcomer to the catalogue, but at least he has the courage of his convictions.

In recent months there has been quite an array of Liszt recordings, and some very fine pianists, old and new, to play them.

But Vasary has no difficulty in holding his own in their company.

You will agree, I am sure, as soon as you hear the first few bars of the sixth Rhapsody, or the Rigoletto Paraphrase.

We expect dazzling technique these days from front-rank pianists, and we get it from an ever-increasing number of them.

What we don't always hear is such a technique completely subordinated to the music, so that when it is used it appears as a flash of brightness or a passage of power which delights us as much for its appropriate insertion as for itself.

And by technique I don't mean merely the ability to play very quickly. This is only part of the gift of building shape and tone colour by the co-ordination of hand and brain.

Vasary has this ability in the highest degree, whether in the sheer delight of the Valse Impromptu where his touch and timing are beyond praise, or the dynamics of the Rigoletto and the far less endearing Campanella, with its triumph of sound over brawn.

But it's hardly fair to mention one piece more than another, for to be honest I have rarely heard a collection such as this in which the honours, and distinguished ones at that, are so equally shared.

The piano tone is most realistic, somewhat remote, and with a cutting amplitude only moderately high. This places considerable emphasis on the surface noise which, on the quieter passages, is only just equal to the occasion.

But with the tremendous dynamic range to be covered, closer miking or heavier cutting would naturally have brought its dangers.

What is remarkable is the absolute clarity of every note, something for which the pianist and engineer can both receive congratulations.

This is one of the very finest Liszt records I have ever heard, and it can be unreservedly recommended.

BRAHMS — Hungarian Dances 1-21. Played by Alfred Brendel and Walter Klein (duo-pianists). Vox APL-9640.

This latest addition to the Vox catalogue is interesting from several points of view.

In the first place it presents the Hungarian Dances, some of Brahms's most popular compositions, in their original form for four hands (and two pianos).

Today we hear them most frequently arranged for orchestra. As the very good jacket notes point out they vary in character from simple, catchy tunes to much more sophisticated works comparable in many ways with the Intermezzos and Rhapsodies which have overshadowed them as piano works.

I doubt whether the complete 21 have been recorded together before.

The second interesting point, to me at least, was that one of the pianists is Alfred Brendel who recently produced such a smashing record of Liszt Concertos.

It's not possible, of course, to identify him as opposed to his partner, but it is possible to congratulate them both on as fine a piece of two-piano work as you are likely to hear.

There is plenty to test their ability both as musicians and executants, but in both respects their playing is clean, clear, lively and delightful.

No one could fail to applaud their vitality and timing and quick response to light and shade.

The recording has a fairly pronounced echo, but this is to the good.

If there is any justification for using two pianos instead of one (and often there isn't!) they must at all costs sound like two instruments.

Close miking and a dead studio would have almost guaranteed failure.

As it is the engineers have struck a pleasant and acceptable balance, if not completely ideal.

It's a pity they have allowed some groove echo to come through.

BIZET — Carmen Suite; L'Arlésienne Suite. Played by the London Philharmonic Orchestra conducted by Anthony Collins and Eduard van Beinum. Ace of Clubs ACLA9.

Once again I was struck with the extremely high pitched nature of the sound characteristic of ace discs.

I don't know how old these recordings are, but they remind me very much of some earlier Deccas in which the top register was accentuated, except that here the boost seems to be overdone.

A great improvement is made by playing back on the old EMI curve and even then by applying some further top cut.

If your equipment isn't elaborate you would do well to use a heavy hand with the treble control.

You will then wind up with a reasonably good result, although one which sounds rather hard by today's standards.

There is nothing wrong with either performance. Both conductors and the orchestra are usually found in the top class releases and on this ground alone the record has good value.

And the surface is commendably quiet

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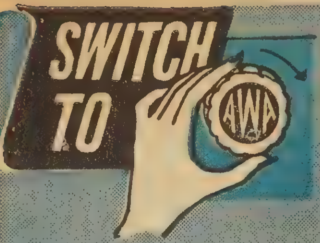

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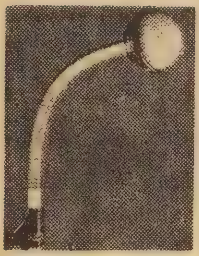
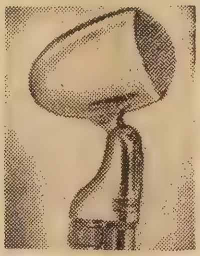
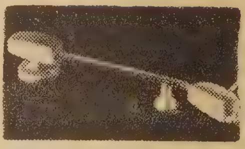
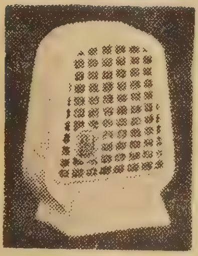
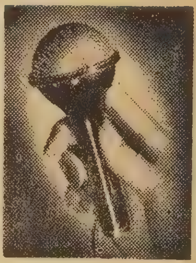
AWA RONETTE

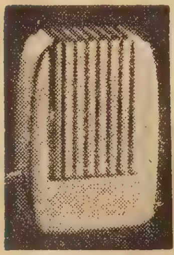

088/F. Filtercell, omnidirectional, with flexible chromium plated suspension

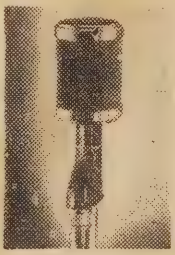

GS210 and GS210/L. Streamlined, chrome finish, filtercell, high or low impedance.

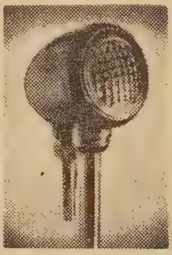

FF2-OV, FF2-P. "Fonofluid" turnover crystal pickup with alternate response characteristics

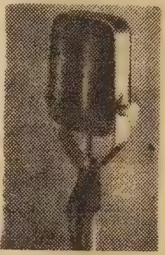

44. Hand or desk mounting, counter balanced base, ivory plastic housing

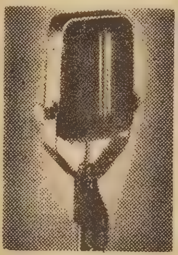

C55. Hand or stand, omnidirectional, black plastic housing and hand grip

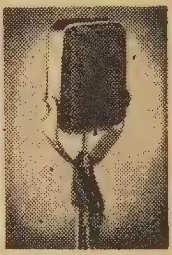

HM7. Hand or stand microphone, filtercell, robust diecast housing attractively finished

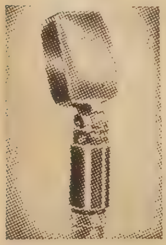

S742. Duo cell, omnidirectional, suitable for cable suspension.


B110. Plastic torpedo form.


R474. Studio type, 4 cell, omnidirectional.


R572 and R572/L. Studio type, duo cell, omnidirectional, high or low impedance.


RFC and RFC5/L. Single cell semidirectional, high or low impedance


RBH/T: Ribbon velocity available high or low impedance.

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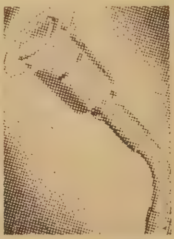
DPH : Dynamic with metal diaphragm. High or low impedance.

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DELIUS.— Appalachia. Koanga (Closing Scene). Played by the Royal Philharmonic Orchestra and Chorus conducted by Sir Thomas Beecham. Coronet KLC 665.

Beecham is probably the finest exponent of Delius, that strange, sensitive and individual genius whose music has always been a subject for controversy, misunderstanding, and neglect.

I am one who agrees whole-heartedly with Neville Cardus in his championship of Delius, and can strongly advise you to read his essay in the book "Ten Composers," most of which he wrote while in Australia during the war.

Appalachia is a general Indian term for the North American continent, and the work is really a set of variations built around the "slave" theme of great simplicity and beauty.

But the Delius use of the variation is far removed from the form so familiar in the earlier works of Mozart and Beethoven. He uses them to create a series of moods which combine into something which is both a rhapsody and a tone-poem, one in which melody and harmony are used with a delicacy reminiscent only of Debussy but vastly different in the essential outlook on music.

Technically it is so surely and beautifully put together that we are apt to overlook the masterly use of tone colours and invention in which the artistry and artlessness of the man is buried.

WRITTEN IN 1902

Appalachia was written in 1902 when Delius was in Florida, where of all things he was occupied in growing oranges and gradually neglecting the job for music which gradually became his life.

In common with a handful of other composers, it is necessary to be mentally and emotionally in sympathy with his outlook to fully appreciate this kind of music, otherwise you will make little of it. Delius is a man with whom comparisons are futile, for his individuality and style have no real counterparts.

No one has introduced the wordless human voice as he has done, and of which Appalachia is such an outstanding example, its effectiveness all the more poignant by contrast with the final section in which a baritone and chorus sing in the manner of a negro folk song. Florida abounded with the remnants of slave labour when Delius lived there, and he was profoundly influenced by this atmosphere.

But words are useless to describe this kind of music — it is to be listened to, and its magic lies in the emergent quality of its sound.

I doubt whether this is a recent recording. It was probably made some years ago, but apart from a dynamic range not as wide as we hear today it is quite good, and the general balance particularly fine.

But far more important is the fine quality of interpretation and performance which I don't think we are likely to hear bettered.

Koanga was written before Appalachia, and the selection which completes the disc is from the final scenes. Absolutely first class.

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SHORT-WAVE NOTES BY ART CUSHEN

SINGAPORE USES 11 METRES

The opening of yet another country on the high frequency band of 11 metres has been observed, with the introduction of broadcasts from Singapore on 25600 Kc.

THE series of cricket Test broadcasts, which have been followed so closely in the United Kingdom, has resulted in the B.B.C.'s Far Eastern Station in Singapore being on the air for the purpose of relaying the commentaries from Radio Australia, to give additional coverage in England. The Singapore station has been heard from 4.30 p.m. to 6.00 p.m. and using two new frequencies in the 13 and 11-metre bands.

Both transmissions are excellent in strength and are heard on 21,485 and 25,600 Kc. These two frequencies are expected in the future to be brought into regular operation for B.B.C. relays, as they have proved so effective in both the European and Far Eastern area.

Cabled reports on the reception were immediately dispatched to London and readers can look forward to yet another country using the 11-metre band effectively.

The B.B.C. Far Eastern Station, which is used to relay the B.B.C. Far Eastern program, and also the General Overseas Service, proves a valued relay point in our winter when direct reception from London is at times impossible during darkness.

The relay station is also valued for the relays of cricket commentaries when teams from Australia and New Zealand are on tour in England. The station has studios in Singapore and the transmitters are at Tebrau in Johore, and use the powers of 100 and 7½ Kw.

XEWW using 6165 Kc.

THE well-known Mexico City station XEWW has recently opened on the additional frequency of 6165 Kc. and is heard here with the same program as on the 9500 Kc. transmitter.

This new frequency is thought to have replaced the old 15,170 Kc. channel, which has not been active for many months.

The broadcasts are on the air from 9.45 a.m. to 4.00 p.m. and use the slogan "La Voz de America Latina" and a three-note chime. The station has been noted with news in Spanish at 3.45 p.m. and closing at 4.00 p.m., followed by a series of identification announcements and a march.

The frequency is one which has some interference from a nearby German signal on 6160 Kc., but during our winter should be heard strongly. The broadcasts at 9.45 p.m., when the station opens transmission for the day, also have the side interference from the FEN Tokyo signal on 6160 Kc.

Ghana uses three channels

BROADCASTS from Accra, in the service of the Ghana Broadcasting Service, have now been established on three frequencies, for the 20 Kw. transmitter. The broadcasts are released on 9640, 4915 and 3366 Kc. On weekdays the station operates 3.50 to 6.00 p.m. on 9640 Kc., 4915 and 3366 Kc.; 10.00 p.m. to 2.30 a.m. on 4915 and 9640 Kc.; 2.30 to 8.15 a.m. on 4915 and 3366 Kc. On Sunday the service is extended to 9.00 a.m. On Sundays the station opens at 3.50 p.m. to sign off 8.15 a.m. on 4915 Kc.; 3.50 to 6.30 p.m. on 3366 Kc.; 5.30 p.m. to 4.30 a.m. on 9640 Kc.; 2.30 to 8.15 a.m. on 3366 Kc. The station features B.B.C. Radio Newsreel at 4.15 p.m. and at midnight, and a relay of the B.B.C. news at 5.00 p.m. and 6.00 a.m.

Service to South Pacific

A LONG, overdue change in the schedule of the special South Pacific service has been made by the Broadcasting Corporation of China with transmissions from Taipeh.

Th transmission was formerly at the unsuitable time of 4.15 p.m., but from last month the service has been included in the former 8.05 p.m. transmission in English to Japan.

This transmission has been extended to 8.45 p.m., and this additional English period has been devoted to listeners in the South Pacific as well as to Japan and Korea.

The frequencies of 7130, 7235, 9575, 11,815 and 15,345 Kc. are employed, and the two former channels being received with better strength. This new time will enable listening throughout this area to be had with good strength and is a more suitable time, the former transmission time was not only unsuitable but also very poorly received.

Notes from readers on the reception of stations should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern Time.

Courier at Rhodes

THE well-known floating transmitter ship, the U.S.N. Courier, has recently been announcing as Rhodes, and has dropped the identification of the ship. The Courier has been anchored in the harbour at Rhodes for many months, and recent reports indicated that the transmitters were being fed to an aerial installation on land instead of the former balloon aerial array.

Courier has been heard on 9630 Kc. and 7125 Kc. in English from 4.00 to 4.30 p.m. The station closes at 4.30 p.m. and identified as "This is the Voice of America transmitter at Rhodes now concluding this portion of today's program."

Light interference from Radio New Zealand is noted on the 9530 Kc. transmission, while the 7125 Kc. outlet suffers severe jamming.

Broadcasts from Taiwan

THE transmissions to the audience on the Chinese mainland from the Taiwan stations are now almost on a round-the-clock basis. The latest schedule from the Broadcasting Corporation of China indicates the station is on the air, 7.55 to 11.55 a.m., 1.55 to 3.55 p.m. and 7.50 p.m. to 4.00 a.m., using BED35 (9555), BED33 (9660), BED36 (9685), BED39 (11,730), BED43 (11,804), BED37 (11,970), BED34 (15,280), and BED38 (15,370). The power of the transmitter is 500 watts, except BED33 and BED43, which are 250 watts.

PUBLICATION PREVIEW

The 1959 issue of the World Radio Handbook lives up to the reputation it has established in its past 12 years as the most complete publication for the radio listener. This comprehensive Danish publication contains the complete details such as address, owners, leading personality, schedules, frequencies, English and other language periods, interval signal, and verification details on every known short wave and most broadcast band stations throughout the world. A comprehensive list of stations by frequency is included, a time chart and many other relevant details in its 160 pages which also include numerous photos and maps. The 1959 issue is available from Arthur Cushen, 212 Earn Street, Invercargill, N.Z. and the price is 15/- posted. Australian booksellers can also supply.

FLASHES FROM EVERYWHERE

IRAN Regional station at Tabriz operates 6152 Kc., with 7500 watts. The station is the air from 12.30 to 3.30 p.m., 5.30 to 9.3 p.m., and 10.30 p.m. to 3.30 a.m.

CAIRO has made a frequency change for i Arabic service, and the transmissions are no carried on 6228 Kc., and this frequency replac 15385 Kc. The station has been heard openi at 1.30 a.m. to 7.00 a.m. The Cairo static has recently introduced programmes in Itali from 5.30 to 5.00 a.m. on 11990 Kc. Th French programmes are from 5.00 a.m. to 5.3 a.m. instead of the hour as in the past.

BRAZILIAN stations in the news include th reception of the new Radio Ministerio de Agr cultura on 15105 Kc. from 5.00 a.m. to 7.3 a.m. This station is located in Rio de Janeiro.

SEOUL, with the broadcasts of The Voice Free Korea, has the use of a new frequency f its North American service. This is now hear on 15410 Kc, HSK 8, from 3.30 to 4.30 p.m

MANILA station of the Far East Broadcastin Company, has made a callsign alteration, following the installation of higher power. The 5 Kw transmitter operates 7.00 to 9.30 a.m. o 11920 Kc, 9.30 to 10.30 a.m. on 15385 K (English), 11.15 p.m. to 2.15 a.m. on 11920 Kc with broadcasts to Indian listeners in local lan guages. The new callsigns are DZF2 on 1192 Kc and DZF3 on 15385 Kc.

HAITIAN station Radio Commerce, which wit its 7500 watt transmitter, is frequently heard i this area, has now all transmissions on 5982 Kc station 4VB. The previous transmissions were o 9543 Kc, which has been dropped from the frequency schedule. The station is located i Port au Prince, and at present is broadcastin from 9.00 p.m. to 2.00 p.m. Radio Haiti, which is using the frequency of 6200 Kc, has an increased schedule and now operates from 9.00 p.m. to 4.00 p.m., and the callsign of this frequency is 4VHW.

TEHERAN has altered its frequencies for its foreign service, and now broadcasts in Persian, 3.00 to 6.00 a.m., on 6047 Kc. Other broadcasts are on 9680 and 17725 Kc, with Arabic (5.15 a.m.), Russian (5.30 a.m.), Turkish (5.45 a.m.), French or German (6.00 a.m.), English (6.15 a.m.).

SEOUL, which has been reported on 9640 Kc. with the transmission at 8.30 p.m. in English, has also been heard with a service to South-East Asia. This service is on the air from 11.55 p.m. with news and news commentary from midnight. The programmes are well received and the station now identifies with the callsign of HLK5.

RADIO ZAMBEZIA, in Lourenco Marques, which we reported as hearing on Monday, t closing at 5.00 a.m., verified by card. The station is operated by the Radio Club of Mozambique, and carries local dialect programmes on the frequency of 3406 Kc. on Monday only. The station identifies with Portuguese when closing and in verifying gives the callsign as CR7BW and the powe 5000 watts.

BRAZZAVILLE has introduced a new 25-metre frequency to its new schedule. The broadcasts from French Equatorial Africa, are now 3.00 t 5.00 p.m. on 5970, 11725 to Africa, 9730 Kc t North America, and on 15440 Kc beamed t Madagascar; 6.30 to 7.15 p.m. the station uses 15440 Kc with programmes to Madagascar: 9.0 to 9.50 p.m. on 15440 Kc beamed to the Middle East; 10.00 to 10.30 p.m. on 15440 Kc to Madagascar. The transmission to the Far East is o the air from 11.30 p.m. to 1.15 a.m. on 1772 Kc; 4.30 to 8.50 a.m. the service is for Afric on 11725 and 11970 Kc. Service to North America operates from 9.00 a.m. to 1.00 p.m. o 11725, while for South America, signals are released on 9625 Kc from 9.00 to 11.15 a.m

HONDURAS station "La Voz del Atlantico" is on the air from 10.30 p.m. to 1.05 p.m. o 4905 Kc. The station is HRQN and as the station is using a new transmitter on this frequency reports are appreciated. "Radio Tegucigalpa" which is using the frequency of 6035 K has been heard with the identification of "HRTN Radio Tegucigalpa, en 980 y 6035 Kc, Calle Embaora del al Cultura." HROW "Radio Monsuratt" which also operates from the Hondura capital has frequency alterations, and is now reported on 5945 Kc.

HRYN4 "La Voz del Meredon" on 6060 K with an English mailbag session on Thursday a 1.15 p.m.

LAOS station Radiodifusion Lao Vientiane, i now 9.00 a.m. to 11.00 a.m., 1.00 a.m. to 4.0 p.m. and 9.00 p.m. to 12.30 a.m. with the powe of 1 Kw. The station, one of the smaller State of the Vietnam Republic, uses 6130 Kc, which from our point of view, means some considerabl interference from the Port Moresby station o the same channel.

AMATEUR BANDS WITH BILL MOORE

Radio Amateurs were active in providing reports from many countries for the IGY project which closed at the end of 1958. It is the intention of a number of National Societies to continue the collection of these reports and so obtain a permanent record of VHF band propagation conditions.

ALTHOUGH the I.G.Y. terminated at the end of December, it appears that similar work vill be continued under the title "International Geophysical Co-operation."

Here in Australia in January amateurs are till plotting the orbits of the latest American atellite and listening to the Russian rocket on ts trip to the moon. They, too, will provide eports of all contacts over 500 miles during heir participation in the Ross A. Hull Memorial Trophy Contest.

English and American amateurs are pushing ahead in an endeavour to bridge the Atlantic on the 144 Mc/s band.

W2CXY is the main station active in the U.S., and to assist in checks runs simultaneous transmissions on 14,095 Kc/s and 144.101 Mc/s. On 144 Mc/s he runs a KW to four 24-foot long yagis fed in phase.

G2NY also runs 1 Kw (special power grant) into a 6 over 6 over 6 over 6 slot fed yagi.

Regular schedules are maintained between these stations and W2CXY also works with PEIPL, DL4WW and G6UF. The tests were part of the British plan for I.G.Y. co-operation.

Other phases of operation carried out during the I.G.Y. year included a serious study of long-range tropospheric propagation and a number of contacts over 500 miles were recorded on 144 Mc/s. More extensive works was carried out over a 200 to 350-mile range.

Many Gs ran regular schedules with PEIPL and GM3EGW and daily records of signals were kept over long periods.

Some success was attained using meteor scatter. The limiting factor was the difficulty of finding suitably equipped stations in Europe for this work.

The Radio Society of Great Britain issued a special certificate to I.G.Y. observers for consistent reporting. The society is considering continuing its I.G.Y. program with emphasis on the various types of VHF and UHF propagation.

In the past no permanent records have been kept on the work of radio amateurs. A continuing program would provide data and a detailed record of the amateur on the VHFs and UHFs would be available.

A meeting of national VHF officers in Europe decided upon several interesting features for organised VHF working.

They decided on a point per kilometre scoring system for all VHF contests as the fairest basis for competition. Contests will be run on an international basis. Logs will be checked by the VHF manager of the country of origin and forwarded to the organising society's VHF manager.

Special CW only contests will be conducted annually on the VHF bands.

SSB VHF is to be encouraged and crystal control as opposed to VFO operation.

Those awards

ANOTHER matter voiced at the IARU Region 1 conference held last year was on the subject of the ever-increasing number of operating awards and contests being announced each month.

Practically every batch of QSL cards received these days brings a new set of rules for one of these contests or awards.

The delegates assembled from the national societies recorded their deep concern at the ever-growing list and they agreed that member societies should be asked to limit the number of such awards and contests.

They considered such limitation would be in the best interests of amateur radio.

The position has now been reached when countries who could only boast a total of 100 licensed amateurs are conducting their own DX contest.

With perhaps some 25 stations operating on the DX bands it is rather difficult to see the value of such a contest.

DX on 50 Mc

THE 50 Mc. band provided good contacts over the Christmas/New Year holidays. At different times ZLs and all VK States were audible around Sydney.

At one period the New Zealand stations were heard on a number of TV receivers on Channel 1.

TECHNICAL DEVELOPMENTS STAR IN 1958

The year 1958 did not see many major changes in amateur radio regulations or operating techniques throughout the world, but technical developments were manifold.

Amateurs were kept busy following the changing technical trends on all spheres of operation.

The year saw little emergency operation, as compared with other years, when amateur operators here in Australia afforded communication during national disasters. Since 1948 amateurs in N.S.W. every year have been active in that field.

The most important contribution during the year by VK amateurs was their work to assist the I.G.Y. project. Amateurs throughout the Commonwealth co-operated in VHF propagation studies and recorded much useful data.

Their work, too, in recording the signals and orbits of the American and Russian satellites was appreciated and is still being carried on by many enthusiastic operators.

EMERGENCY NET

In N.S.W. perhaps the most important phase of operation has been in the final organisation of the emergency net.

Under State Emergency Co-ordinator, Bob Godsall, VK2ARG, the Wireless Institute Civil Emergncy Net was made fully operative. The culmination of the net-member efforts was the display in November of the net and VK2WI control station in operation to the heads of the Civil Defence Organisation at their headquarters in Sydney.

Not to be forgotten was the work in 1958 by the Federal Executive of the WIA in establishing the ITU Delegates' Fund and the final selection of John Moyle, VK2JU, as the official observer adviser.

With the improvement in propagation conditions, due to the reaching of sunspot maxima, 1958 will be remembered for the continued opening of the 50 Mc/s for DX contacts throughout the world. During the year the first 50 Mc. WAC was issued, although the final contact was made late in 1957. The first VK/W contacts across the Pacific were made early in the year.

Australian amateurs received a power increase to 150 watts during the year.

Quite a deal of news was forthcoming in overseas journals of the preparation for amateur representation at the ITU general conference.

During the year the N.S.W. Division of the WIA topped the 1,000 membership mark, the highest on record. By way of comparison, the U.S. amateur population during 1958 increased at the rate of over 1,000 new licences per month.

SSB transmissions could be heard more frequently during the year, especially on the 14 Mc. band, where the DX potentialities of this mode are fully realised.

On the DX front DX-peditions journeyed to many and varied spots on the globe with resultant increases in country tallies. Also to assist these tallies, many new countries were recognised by the certificate-issuing authorities. Some of these are little more than rocks jutting up in some ocean or other. It adds interest, for the DX exponents, but seems to make a sinecure of country recognition.

The Western Australian Division won the Remembrance Day Trophy for the second year in succession.

Very few regulatory changes were noted for amateur stations anywhere in the world. Perhaps everyone is holding back, awaiting the outcome of the Geneva ITU conference deliberations as they affect amateur radio.

The HF bands provided much enjoyment for operators inclined toward DX working. The 14 Mc. and 28 Mc. plus 21 Mc. bands' conditions were in better shape than perhaps since the DX peak of 1947-48.

The only problem during these sunspot maxima is, of course, the prevalence of ionospheric disturbances and the resultant blackouts and lack of DX.

The year 1958 witnessed much progress in amateur affairs in Australia—a tribute to the many volunteers who manage the administrative side of the Wireless Institute of Australia.

PROGRESS AT VK2WI

THE VK2WI project at Dural is gradually taking shape in what may be its final form (as final as any amateur installation can be).

Last year saw a tremendous change in the general arrangement of the equipment, due mainly to the work of the official VK2WI crew, together with the help of many other amateurs and associates.

The station is available for the training of any members who desire to learn broadcast station control and installation.

The gear in operation would be practically the equivalent of many commercial stations with additional transmitters operating simultaneously.

Three high-power HF transmitters operating up to 500 watts and two 100-watt VHF transmitters are available for simultaneous operation controlled by a single key switch.

The N.S.W. Council is desirous of seeing members becoming fully acquainted with the operation of VK2WI and engineer Dave Duff, VK2EO, would be pleased to see amateurs at Dural for this purpose.

The 25 KVA emergency power plant is installed and helpers are required to make the unit fully operative.

In the gardening field most of the work has been carried out by members of the Short-Wave Listeners' Group, but further assistance is also required in this field.

Emergency call

ON January 3 and 4 N.S.W. radio amateurs on the North Coast were active on the WICEN frequency of 7050 Kc/s. Heavy rains along the coast had caused minor flooding, cutting the main highway in a number of locations. Fortunately the rain eased and by the 5th possibility of serious flooding had eased.

Main centre of flooding was at Port Macquarie, where Lou, VK2AWS, and Les, VK2ALM, were active and handled messages with VK2WI for Civil Defence Headquarters.

A number of amateurs were active on the frequency and official control station for WICEN, VK2WI, acted as the Sydney link.

This was the first WICEN run under emergency condtiions and messages handled were in accord with the official net routine.

Membership Fees

MOST divisions of the WIA are finding it necessary to raise membership fees to cover the ever-increasing costs of running the institute. Fees for full members are already up to £3/3/- in some divisions and that sum is barely sufficient to cover the outgoings.

The N.S.W. Division will discuss all aspects of finance and the increasing of fees at a special general meeting to be held in January.

The service rendered to amateurs by the divisions of the WIA is invaluable.

Members who provide their services free should not be required to work with insufficient funds available for the effective working of the sections of the WIA.

Christmas meeting

BILL STORER, VK2EG, a member of the first expedition to Mawson, provided a lecturette after a showing of Antarctic films at the December meeting of the N.S.W. Division.

Joe Reed, VK2JR, who returned from overseas last year, showed colour slides of the Farnborough Air Display, the Brussel Exposition and other events. Joe also played a recording of the signals bounced back from the moon as received on the radio telescope at Jodrell Bank, England.

By courtesy of Mullard, Aust., a technical film on transistors was also shown. As usual the December meeting took the form of a film evening and many XYLs, YLs and juniors were in attendance.

The new AOCP class of the N.S.W. Division will commence in February and interested persons in Sydney and its surrounds should direct inquiries to the Secretary, WIA, N.S.W. Division, Box 1734, G.P.O., Sydney, for details. The division's correspondence course for the amateur's certificate runs continuously and information can be obtained from the same address.

TELESCOPES

30 x 40 coated lens with tripod. Suit rifle clubs, etc. Length 28 inches, weight 1½lb.

£7/19/6

Post 4/6; Int., 5/10.

TRIPODS

Ex-Army. Ideal. Dumpy Levels, Theodolite, Telescope or Instrument Stand Brass.

£6/10/- each

Freight payable at nearest attended railway station.

ALTIMETERS

Brand New. Ex-R.A.A.F. 0 to 40,000 feet.

£1 each

Post, N.S.W., 2/1, Int., 3/3.

COPPER WIRE

BRAIDED.

Ideal Aerials etc.

6/11 per 100 ft.

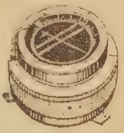
Post N.S.W., 2/6; int., 3/11.

OIL PRESSURE GAUGES

New. Suit cars, trucks, boats, stationary motors, etc. 0-150lb sq. in.

£1 each

Complete with tubing. Post N.S.W., 2/1; Int., 3/3.



P8 COMPASS

Liquid filled. As new. Ex-R.A.A.F. Ideal for small boats, etc.

£3/15/- each

Post, N.S.W., 4/5; Int., 5/10.

PRISMATIC COMPASSES

Ex-Army. LUMINOUS. Guaranteed Correct.

£7/15/- each

Post, N.S.W., 3/-; Int., 4/-.

TV ANTENNA KIT

SIMPLE. DO IT YOURSELF.

Complete with tubing and suggested diagrams. Instructions supplied.

£3/9/6

Shop sales only.

VOLTMETER

Pocket Size.

0 to 15 volt D.C. and 0 to 250 volt D.C., with probes. In water-proof Canvas Case.

33/6 each

Post 3/4. Int., 4/6.

DIRECTOR DUMPY LEVEL

WITH BRASS STAND.

£22/10/-

Freight payable at nearest attended railway station.

PROJECTION LENS

4½in Dual Condenser Lens System with spherical reflector and adjustable lamp. Ideal enlarger or projector, complete with housing.

£12/10/-

Add 5/- cartage to rail. Freight payable at nearest attended rly. stn.

LEAD THROUGH INSULATORS. 3/6 ea. Porcelain. Add postage

TELESCOPES EX-Army

Ottway of London. With variable power adjustments. Length 26in. Weight 12lb.

£12/10/-

Freight payable at nearest attended railway station.

LENSES

PLANO-CONVEX.

2 3/8in diam. New 10/ each. Add postage. Also assortment prisms, lenses, eyepieces, gears, etc.

GUNSIGHT COLLIMATOR

Contains Acromatic Lens. 1 7/8in diam. 4½in F.L., front silvered diagonal eliptical mirror, two worm traversing gears, sundry tubes, connector mirrors, etc.

27/6 ea.

Post, N.S.W. 3/2, Int. 4/7.

CHOKES

BRAND NEW.

7.5 Henrys. 125 milliamps.

9/6 ea.

Post, N.S.W. 3/2, Int. 4/7.

TWO GANG CONDENSER

Variable. Brand new.

15/- each

Post, N.S.W., 2/6; Int., 3/11.

BOWDEN INNER STEEL CABLE

Ideal for brakes, steering, rudder, etc 1/- per yard. Bowden Outer Cable.

6d per yard

Minimum 10yd. Please add Post.

BALL BEARINGS

¼in-I.D. ½in-O.D.

24/- dozen

Post, N.S.W., 1/9; Int., 2/9.

CONDENSERS

A.W.A., .01 5/- doz. Block Condensers, Bakelite, .01 MF 750v, D.C., 6/- doz. Ducon 400 MFD, 12 P.V., 6/- doz. Add Postage.

METERS

In Polished Wooden Case and Leather Carrying Case. Siemens, ex-Army. Dimensions 7in x 7in x 4in. 0 to 1 Milliamps, D.C.,

£5/5/-

0 to 50 Amperes, A.C.,

£7/5/-

Post, N.S.W., 6/2. Int., 9/6.

HEADPHONES

High Impedance. Suit Crystal Sets. Lightweight. American.

22/6 pair

Post, N.S.W., 2/1; Int., 3/3.

FIBRE PULLEYS (AMERICAN)

BALL-BEARING

1 3/8 diam., ¼in shaft, 30/- doz. 1¾ diam., ¼in shaft, 42/- doz. 2 3/8in diam., 3/8in shaft, 54/-. 3½in diam., 3/8in shaft, 66/- doz. Add Postage.

AIRCRAFT GENERATOR

24v. D.C., 100 amp.

£17/10/-

Freight payable at nearest attended railway station.

MANIFOLD PRESSURE or VACUUM GAUGE

NEW.

£1 each

Post, N.S.W., 2/1; Int., 3/3.

VALVES

1.4 Miniature Series. New.

1R5	12/6
1T4	10/-
1S5	10/-
3A4	12/6

OTHER VALVES. ALL NEW.

GL8020 15/-; EL5 7/6; HA2 Acorn 15/-; H30 Duo Triode 7/6; EB34 7/6; HA1 Acorn 15/-; EF8 7/6;

Cathode Ray Tube with socket. Type 4/1, new, 29/6. Add Postage.

Mechanical REV. COUNTERS

BENDIX.

New, 0 to 3000 r.p.m.

£4/19/6 each

or complete with flexible drive.

£6/15/-

Post, N.S.W., 3/4; Int., 4/6.

SHOCK MOUNTS

1¼in. New. Made in U.S.A.

7/6 a doz.

Post, N.S.W., 1/9; Int., 3/3.

TRANSCEIVERS

2-Way Radio

No. 22 without power supply. £4/10/-.

No. 19, 15 valves, etc., £4/19/6.

No. 128, 2 to 4.5 megs., Ideal ship to shore, fire-fighting, etc. £12.

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Contain sundry gears. Coil, Electrical and mechanical parts.

Only 9/6 each

Plus 3/6 cartage. Freight payable at nearest attended railway station.

GENEMOTORS

D.C. Input. 28v. D.C. Output. 250v.

30/- each

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MAKE YOUR OWN DUMPY LEVEL

with Astro Compass, 25/6.
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AMERICAN RELAYS

24v S.P.D.T., 12/6 ea. Miniature.
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200w T.P.D.T., 17/6.
200 ohm S.P.S.T. 15/-.
Time Delay D.P.S.H., heavy duty.
24v Western Elec., A.C., 45/-.
24v D.C., S.P.D.T., 17/6.
24v 200 ohm LEACH S.P.S.T. heavy duty, 27/6.
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10,000 ohm S.P.S.T., 19/6.
5 and 10 ohm T.P.D.T., 15/-.
28v heavy duty D.P.D.T., 27/6.
Post 1/9.

WOBBULATOR OR MODULATION UNIT

50/- each

Post, N.S.W., 4/6; Int., 5/10.

AIR TEMPERATURE GAUGE THERMOMETER

0-30 minus C 0.50 Plus C. Suit Coolrooms, Electroplating Works and 1,000 other uses.

£1

Complete with tubing. Post, N.S.W., 2/1; Int., 3/3.

AIR SPEED INDICATORS

NEW.

£1

Post, N.S.W., 2/1; Int., 3/3.

TOGGLE SWITCHES

Two-way with silver contacts. Ex Command.

4/6 each

Post, 9d.

POTENTIOMETERS

50,000 to 100,000 ohms.

3/6 each

Add Postage.

WHIP AERIALS

Ideal for car or TV antennas or blackfish rods. 13ft in 12in sections.

19/6

Post 1/9, Int., 2/9.

TRANSFORMERS

TRANNIES, midget output, 5/- ea.
TRANNIES, I.F., 1600 K/cs, 5/- ea.
TRANNIES, ex-Navy. Can type. 5/- ea.
TRANNIES, power 0210, 230-250 V. Prim, 6.3 Amp. Centre tapped 5V, 2 Amps, 315-0-315 V., 35/- ea.
TRANNIES, 115V, 40-0-400 V., 400 V-210-0270-400 V. 3 Filament, 35/- ea.
TRANNIES, 115V. to 6.3 Trimax, 10/- ea.
TRANNIES, Canadian, voltage unknown, these can be rewound, 15/- ea.
TRANNIES, heavy duty, 240V. input 6.3V., 5V., 325V., ext. 400V. A.W.A., £4/15/- ea.
TRANNIES, Trinaz, 330V, primary 5V, C.T. 6.3, 285-0-285, 45/- ea.
TRANNIES, heavy duty primary 240-V., 1.5 Amp. Sec. 22-0 Kilo. V.O. 15 Amp. Rating 0-33 K.V.A. Wind double phase 1 freq. 50 cycle, A.W.A., £10 ea.

Please add postage.

Radio Experimenter SPECIAL MIXED LOT

2 Potentiometers, .1 meg.; 3 doz. assorted resistors, values ranging from ½ to 2 watts; 9 assorted Condensers; 1 Midget Choke, single wound; 1 Midget Choke, double wound; Output Transformer; 2 H.F. Transformers; 1 H.F. Reactance Ceramic; 1 hank of ass. Hook-up wire, approx. 40ft; 3 lengths of Multi Core Cable, and lots of other items too numerous to list.

THE LOT 45/-

Post, N.S.W., 3/9; Int., 5/2.

TELEPHONE CABLE

BRAND NEW, NYLON COVERED

£4/17/6 per mile.

Freight payable at nearest attended railway station.

DEITCH BROS.

70 OXFORD STREET, SYDNEY

Between Crown and Riley Streets, City.

The ITU Fund

DONATIONS for the WIA's ITU Fund are still being received, but rather slower than previously. The tally at the end of the year was £1,900. Now the delegate has been selected it could be expected that the donation rate will again increase. The target figure is £2,500 and only a few months remain to reach this amount.

Amateur representatives at Geneva will appear or some 250,000 licencees throughout the world and all members of the movement should directly upport the appeal.

Donations should be sent to the Federal Secretary, WIA, Box 2611W, G.P.O., Melbourne.

Moon bounce

U.S. amateurs have again been asked to co-operate by reporting on the Moon Bounce signals transmitted on a frequency of 151.11 Mc/s by the U.S. Army Research and Development Laboratory.

Hundreds of amateurs assisted by reporting on previous tests. The transmitter output runs at 50 Kw. and the antenna a gain of 25 DB. Twenty megawatts are directed to the Moon and tests are run over eight-day periods when the Moon is in the proper phase.

Remote Control

PROPOSED new regulations in the U.S.A. cover the use of remote control by radio using the 220 Mc/s band and AFSK over the entire 50 Mc. band.

The reason for the granting of permission for remote control on 220 Mc/s is to allow stations in the RACES (Radio Amateur Civil Emergency Service) to control remote base stations. It will allow the full capabilities of the service to be realised and eliminate the necessity of physically relaving messages and the use of wire lines.

There is always a possibility of this in times of disaster of line failures. Special applications will have to be made to the FCC, giving full details, before remote control will be permitted.

The granting of AFSK facilities on 50 Mc/s is also to assist the RACES organisation. It would permit the simultaneous transmission and reception of radio teletype signals and make the fullest use of the band.

TVI in Britain

THE increasing use of non-resonant television antennae, particularly of indoor type, has caused some concern in Great Britain. TVI is more readily caused using these antenna

The TVI and BCI committee of the RSGB is satisfied with the approach of the post office to this problem. It is covered in pamphlet issued by the authority and reads as follows:—"It is even more important for television than for sound broadcasting to have a good aerial in the right place. If you are getting interference with an indoor antenna, you should ask your dealer to demonstrate the effect of an outdoor variety. ."

Plan for 14 Mc

LEADING DX exponent, VQ4ERR, offers a planned arrangement for the use of operators on the 14 Mc. band. Such a scheme of sub-allocations could assist in reducing the ORM problem and at least allow the various stations to know where to operate. The listed arrangement is possibly too complex, but some such project could be of value. The suggested plan is as follows:—

14,000 to 14,100 Kc/s—CW only; 14,100 to 14,200—"Foreign" (to the U.S.) AM no CW; 14,200 to 14,250—U.S.A. AM only; 14,250 to 14,275—U.S.A., SSB and AM; 14,275 to 14,280—only U.S. Pacific's KB6, KC6, KG6, etc.; 14,280 to 14,295—U.S.A. SSB ragchewing; 14,295 to 14,300—U.S.A. DX Hunting SSB and invited AM; 14,300 to 14,305—special DX-peditions, rare or new countries that will invite AM and SSB contacts in turn; 14,305 to 14,310—Foreign SSB DX Hunters and invited AM; 14,310 to 14,320—Foreign ragchewing department; 14,320 to 14,330—Foreign SSB and AM; 14,330—14,350 free for foreign stations, for traffic to the U.S., the extra KW DL4s, etc.

The plan incorporates many good ideas. Utopian perhaps, but it would be appreciated by most operators if the tangle of CW, AM and SSB signals often heard could be at least reduced

Hal, SVOWAE, is still doing a fine job keeping the island of Rhodes on the DX map. He is active most evenings around 2,000 hrs. EAST on 21,120 Kc/s. You can QSL him via the bureau or direct to Box 564, Athens, Greece

Elaborate Antenna

W1FZ must own one of the most comprehensive antenna arrangements yet erected on a single pole. The mast weighs 4 tons, its height is 111ft with over 11ft in the ground anchored in nearly 40 tons of concrete. The whole mast revolves within a tube and a single coaxial line connects the arrays to the shack. Co-ax relays switch this line to any of the six arrays. Stacked yagis are used on 14, 21, 28 and 50 Mc. bands.

Three elements are arranged for 7 Mc and a long yagi on 144 Mc/s.

TELEVISION F.M. and BROADCAST

Standard Components for Receivers ex Stock or on Short Delivery

★ All types of iron cored and air cored transformers, inductances, special windings, sub assemblies or assemblies to **your** specification.

★ Design or development of electronic and electro-magnetic devices and circuits undertaken.

★ Production capacity for small or large quantities at unmatched prices.

Complete Range of Following Now Available

- **Vertical blocking oscillator transformers.**
- **Horizontal blocking oscillator coils.**
- **Sine wave coils.**
- **70°, 90°, 110° flyback transformers.**
- **Bifilars with and without cans suitable for staggered tuning.**
- **Sound and limiter I.F. transformers.**
- **Ratio detectors.**
- **Peaking coils and traps.**
- **Car radio vibrator transformers.**
- **Coils and transformers for Broadcast and S.W., including Flying Doctor etc. (standard and miniature).**
- **Power transformers**
- **Chokes**
- **Audio transformers (standard and Hi-Fi!)**

Should any items you require not be listed, quotations can be supplied promptly without obligation.

In addition our Laboratory Engineers are readily available to assist with design on application problems—another Telecomponents service.

Wholesale and trade enquiries are invited with an assurance of scheduled deliveries, top quality and olwer prices.

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TELEPHONE XF0221

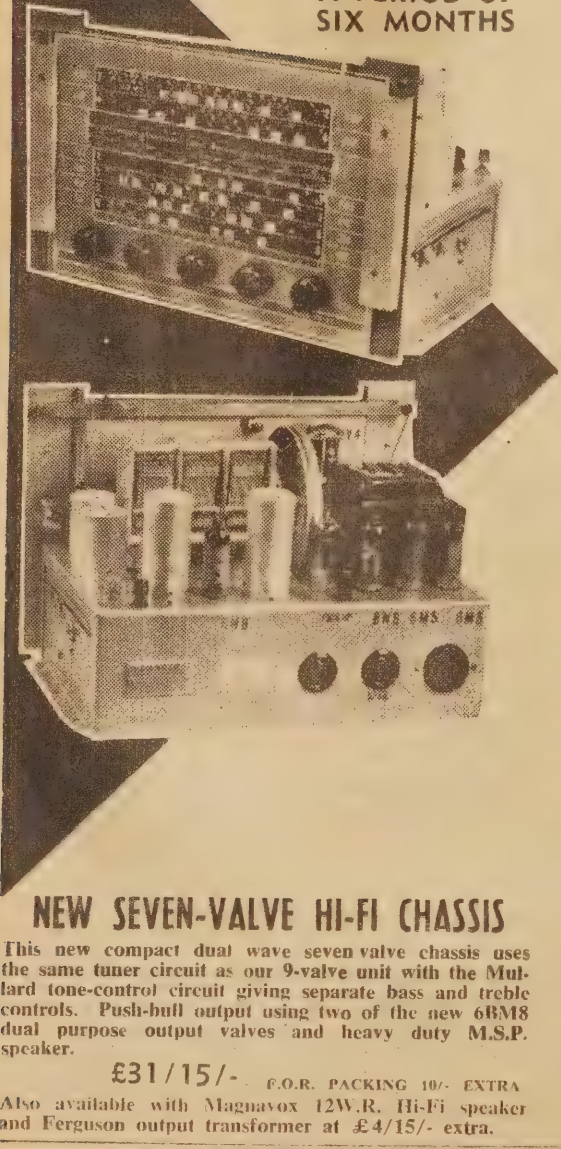
before purchasing your radio see our—

Hi-Fidelity

RANGE

and compare these NEW features..

ALL CHASSIS GUARANTEED FOR A PERIOD OF SIX MONTHS



NEW:

Ultramodern circuit using nine high gain valves including "magic eye" tuni indicator. Permatuned iron cored coils and intermediates giving excellent inte state reception and a short wave range of 12.000 miles. All valves used a the new Mullard nine pin Innoval series.

NEW:

Ton control and audio stages incorporating the Mullard 5/10 amplifier circu with separate bass and treble controls giving plus or minus 15 db boost or c at 50 cycles L.F. and 10.000 H.F., combined with push-pull output with invers feed-back gives you really high fidelity reproduction from your radio or favouri recordings.

NEW:

Dual Speaker combination, using a heavy duty woofer (12in M.S.P. Jensen AU5 special) with matching 6in tweeter and cross-over network giving a frequenc response of 46 to 13.000 cycles. Speakers are mounted coaxially making onl one .11in mounting hole necessary.

NEW:

If required the new Magnavox high-fidelity twin coned speaker can be supplied Large calibrated edge-lit dial in plate glass (11in x 7in) with main stations o each State in prominent type. Dial fitted with counterweight drive, giving smoot tuning. Indicator lights are fitted showing which band is in operation. Dia can be supplied in cream, black or brown with matching knobs and escutcheo to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positiv even on interstate, overseas and country stations.

All chassis are wired for the fitting of F.M. tuner or tape recorder, specia plug being provided on back of chassis, also pick-up terminals and outlet fo gramo motor.

Power switch is fitted to volume control, radiogram switch, combined with wave change switch. Audio end of set can be used with TV receiver if required.

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT Frequency response 40-13,000 cycles Max output 10 watts.

£41/15/0

F.O.R.

A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST

The ideal chassis for those difficult locations where reception is doubtful. Specifications are nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short wave bands.

£44/15/0

F.O.R

NEW SEVEN-VALVE HI-FI CHASSIS

This new compact dual wave seven valve chassis uses the same tuner circuit as our 9-valve unit with the Mullard tone-control circuit giving separate bass and treble controls. Push-bull output using two of the new 6BM8 dual purpose output valves and heavy duty M.S.P. speaker.

£31/15/- F.O.R. PACKING 10/- EXTRA

Also available with Magnavox 12W.R. Hi-Fi speaker and Ferguson output transformer at £4/15/- extra.

Write for full specifications

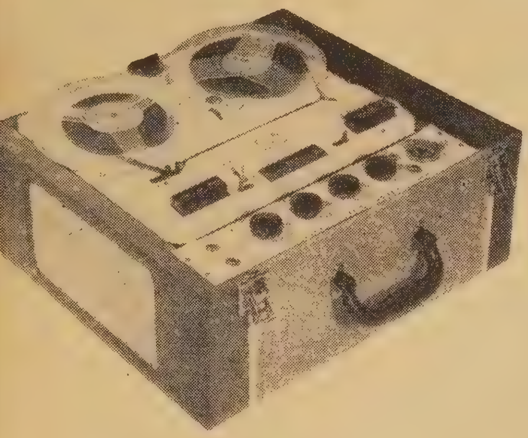
ALL 4 SPEED RECORD CHANGERS AND PLAYERS STOCKED

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145

Buying a Tape Recorder?

First see and hear the new Hi-Fi Recorder by Classic incorporating the new Collaro Mark IV Transcription deck. The only deck with ALL these features.



THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE PLASTIC-COVERED CASE COMPLETE WITH ACOS MICROPHONE AND FITTED WITH DUAL ROLA SPEAKERS

The six-valve amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Record monitoring and outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck.

- **HIGH FIDELITY**
Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
Instantaneous changes can be made from one track to the other Fast rewind in either direction
- **CONSTANT TAPE TENSION**
A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan
- **FULLY MECHANICAL**
No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical
- **FINISH**
Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
3¾, 7½ and 15 inches per second
- **FOUR HEADS**
Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections Control will only work whilst it is held in position
- **TAPE MEASURING & CALIBRATING DEVICE**
The three digit counter makes the location of any recorded passage the simplest of operations
- **TRANSCRIPTION TECHNIQUE**
A large diameter flywheel with ground and lapped steelshaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 to 1.0 per cent.
- **TWO MOTORS**
Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear

COMPLETE RECORDER WITH MIKE — 84 GNS. f.o.r.

DECK WITH AMPLIFIER, POWER SUPPLY and 6in x 9in SPEAKER, 71 GNS.

BUYING STEREO EQUIPMENT?

First see and hear our complete Range of **Stereophon** Hi-Fi Stereo Units

Complete Tuner and Amplifier for Stereo comprising a compact Hi-Fi 13 valve stereogram in two units featuring a dual wave tuner with R.F. stage multi-input two channel pre amplifier with tone controls in one unit and two 7 watt push-pull amplifiers with power supply in second unit. Two pair of M.S.P. or two Magnavox 12WR are supplied.

£63'17'6
F.O.R.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD. N.S.W. PHONE UA2145.

TRADE IN YOUR OLD INSTRUMENT

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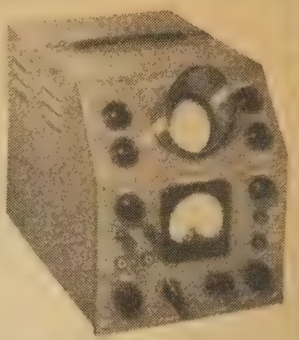

The E.M.I.-W.M.S. oscilloscope
a portable, wide-range instrume
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in-built vacuum tube voltmete
strong steel case in attractive tw
tone green finish.

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A CRYSTAL CONTROLLED 144 MC CONVERTER

(Continued from Page 87)

ase, n stands for the number of times requency multiplication is required of he second 12AT7 stage.

Tunable IF range 3 to 7 Mc.
9400 Kc where n is 5.
7833.3 Kc where n is 6.
6714.3 Kc where n is 7.
Tunable IF range 6 to 10 Mc.
9200 Kc where n is 5.
7666.6 Kc where n is 6.
6571.4 Kc where n is 7.
Tunable IF range 14 to 18 Mc.
8666.6 Kc where n is 5.
7222.2 Kc where n is 6.
6190.4 Kc where n is 7.

The higher frequency crystals (n equals i) are to be preferred both to avoid purious responses and also to keep the oscillator injection high. The overall ost of a special crystal ground to frequency may not be much greater than hat of a cheaper low frequency crystal plus the extra multiplier stage which may e needed.

COIL RANGE

Coil specifications given allow the converter to work with crystals between 6 and 9.5 Mc. For lower frequency rystals it may be necessary to add turns o L2 or increase the capacity of C17.

A certain amount of adjustment of the rystal oscillator circuit may be necessary depending on the particular crystal you use. There are a few crystals which will not oscillate at all in the ircuit, but the percentage is small and you would be very unlucky if the crystal were at fault.

Begin the adjustment procedure by onnecting a 0 to 1 mA meter in series with the earthy end of R14, positive end o ground. Plug in the 12AT7 valve and arrange for heater and high tension supply, the former being 6.3 volts at about 1.2 amps and the latter 250 volts at about 30 mA total with all stages operating.

With the crystal plugged in, switch on the high tension supply and vary C17 throughout its range. If no grid current is indicated and all else is in order, the probable explanation is that more turns are required on L1. On the other hand, if grid current is indicated over the entire range of the capacitor, even if it varies with the setting of C17, it would suggest that the oscillations are not crystal controlled.

ADJUSTMENT

In that case, take 1 turn off L1 and try again. With the correct amount of feedback, grid current due to uncontrolled oscillations will appear at the minimum capacity end of the range of C17, increasing capacity will cause oscillations to cease, a further increase will cause crystal controlled oscillations to start gradually increasing in amplitude until they stop suddenly close to the peak on the high capacity side. A fine adjustment of feedback can be made by moving L1 in relation to R2.

If adjusted to the peak, the circuit probably will not start oscillating after a break in the high tension supply. The optimum setting is determined by starting with maximum capacity and gradually decreasing the value until oscillation starts. Switch the high tension off and on a few times to ensure that the oscillator starts promptly each time.

A grid dip oscillator is a great help in the adjustment because it allows you to pre-resonate L2 C17. The optimum inductance on L2 is that which permits the circuit to resonate at three times the crystal frequency with C17 at about 20 pF.

Also a communication receiver covering the overtone frequency and with a BFO is handy to establish definitely that the oscillator is crystal controlled. A typical clean crystal beat note should be heard and the frequency of the beat note should be barely affected when the hand is moved near oscillator components.

PRECISION REQUIRED

With the oscillator operating correctly the remainder of the coils should be made exactly according to the specifications and wired in place. We cannot overstress the need for following the coil information especially if you do not have a grid-dip oscillator covering the range.

If a grid dip oscillator is available, the following procedure is suggested by the W.I.A. All valves should be in their sockets. "With power removed, check L4, L5, L6, L7 and L3. L4—140 Mc; L5—145Mc; L6—145.5 Mc; L7—144.5 Mc; L3 (144 minus IF) Mc. L4 will be fairly broad, L5 will be as broad as a barn door and is not critical, L6 and L7 will be sharp. L3 can be adjusted to resonance with C19 the others by squeezing the turns closer together or vice-versa. When dipping any coil the adjacent coil/s should be detuned by temporarily connecting a 47 pF across it, e.g. when dipping L7 detune L6 and L3.

"If no GDO is available you will have to rely on making the coil exactly to the dimensions given.

"Now mount the converter in its box. The removable plate of the box now the bottom plate which should be left off until the tuning operations are completed.

CHECKING COILS

"Apply power and an antenna to the converter and couple its output to the tunable IF channel. Make sure that the oscillator is functioning correctly and then tune in a steady signal. Swing the beam so that the signal is about S5. L4, L5, L6, L7 and L3 should be finally adjusted for maximum output by checking with a tuning wand.

"A tuning wand is a piece of insulated rod with an iron dust slug on one end and a small piece of brass tube on the other. Two separate rods may be used. The diameter of the slug and the tube should be such that they can be inserted within the coils. The brass tube should be covered with a piece of nylex sleeving.

"The wand is used in the following manner. First the iron dust slug is inserted into the coil and then the brass slug. If the iron slug causes the output to increase, then the coil is too small. If the signal increases as the slug is brought near the coil and then decreases as the slug gets closer, the coil is only a small amount off resonance. If the slug can be inserted right into the coil and cause the output to increase all the way, then the coil is well off resonance.

"If the brass slug causes an increase in output then the coil is too large. When the coil is correct either slug will cause a decrease in output. For best results L4 should show a very slight increase with the brass slug, L6 should be peaked on a signal of 145.5 Mc and L7 on a signal of 144.5 Mc.

"Now find a very strong signal — S9 plus. Disconnect one end of R2. Adjust Ln for minimum signal strength, again using the tuning wand. The signal you use for this adjustment should arrive via the aerial and not by direct radiation as from a GDO.

"Reconnect R2 and the converter is ready for use."

Our own suggestion is that you start with more turns than specified on Ln and find the optimum setting using the brass end of the tuning wand. It is much easier to remove turns than make a complete new coil at each check.

SPURIOUS SIGNALS

It remains to mention that a possible source of spurious signals within the tuning range of the receiver is the oscillator of the communication receiver itself. Harmonics of the oscillator may be radiated and come into the aerial circuit of the converter, leak back through the RF connecting cable or be conducted by common power supply cables.

Steps can be taken to attenuate at all three points mentioned, but the trouble is not always justified because the signals have a much higher tuning rate than the desired signals, being high order harmonics. It is always possible to fit the desired signal within the bandpass of the receiver without interference from the oscillator harmonic.

There is always the point of view that these signals do confirm that the converter is operating at full sensitivity when checked a subsequent time.

MORE ABOUT AMPLIFIERS FOR USE IN CHURCHES

(Continued from Page 79)

ficulty in hearing would miss occasional words when not using earphones even when they sat near a loudspeaker. Provision of loudspeakers therefore does not do away with the need for earphones, as was mentioned in your article.

"The microphones were moving coil type with line impedance of 50 ohms and my experience was that only microphone transformers of the shielded type could be used on the chassis if a high signal-to-noise ratio was to be obtained. With unshielded transformers the hum level was high enough to be audible at normal working level even when the transformers were in a position of minimum hum pickup."

The above comments apply to a church about 60ft by 40ft, having a very high ceiling and of such construction as to cause severe echoes. One of the reasons for providing the speakers was so that people at the back of the church could understand what the preacher was saying without the sound being severely distorted by the echoes.

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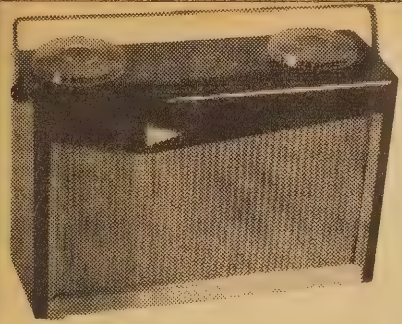

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7 TRANSISTOR PORTABLE

Specifications as above but with extra I.F. stage, giving better range and selectivity, also has extra coil for connecting to car aerial, making it ideal as a car set or for country locations. . . . .
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Complete kit including B.S.R. motor and pick-up (4 speed), Rola speaker, batteries and two-tone plastic-covered cabinet. . . . .
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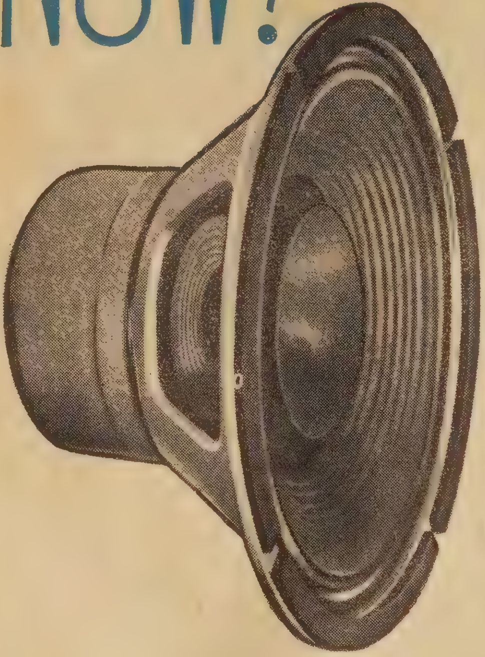

WIDE RANGE

and

HIGH FIDELITY LOUDSPEAKERS

These nine combinations of Rola loudspeakers have been evolved to give the high fidelity enthusiast a choice which will ensure the best possible performance from his equipment.

As shown diagrammatically at the right, they start with a single 8-inch low frequency unit and a high frequency tweeter combination intended for use where cabinet space is limited.

In successive stages, they progress from multiple 8-inch and 12-inch speaker combinations to the extended range coaxial models, culminating in the famous Hi Fi 12Ux, unquestionably the finest loudspeaker money can buy.

No matter what your Hi Fi requirements, there is a Rola loudspeaker or group of loudspeakers which will fully meet your requirements in both performance and cost . . . Rola Quality is Traditional.

ROLA

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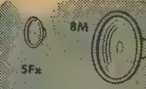
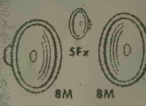
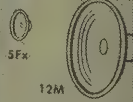


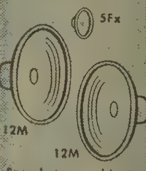
For use in small cabinets where limited baffling is available.



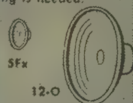
For intermediate sized cabinets and higher power handling capacity.



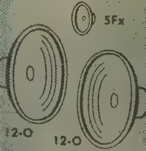
For medium sized open backed cabinets and small amplifiers.



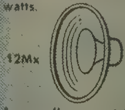
For larger cabinets where ample baffle area is available and greater power handling is needed.



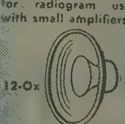
For similar applications to the preceding group but at powers up to 7 watts.



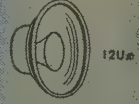
For use in adequately baffled cabinets at powers up to 14 watts.



An excellent coaxial-type single speaker for radiogram use with small amplifiers.



Similar to the 12Mx but with an extended frequency range and better power handling capacity. Works best in a vented enclosure.



Irrespective of price, the Hi Fi Model 12Ux is without doubt the finest loudspeaker available. Although it gives best results in a properly dimensioned vented enclosure, it performs brilliantly in a standard open-backed radiogram cabinet and will handle up to 20 watts of power.

The serviceman who tells

(Continued from Page 95)

om it. All things considered, I felt at the idea was justified on the basis at slightly reduced performance was whole lot better than none at all.

However, the problem was still not mpletely solved. Some means had to found whereby the owner could proide such a modified battery at any reasnable time or place without having to list the aid of a serviceman and exlain the whole story over again.

Since 67.5 was the voltage required, I oncentrated on what could be done ith this size battery. Slipping it out of s carton I studied the three stacks and onsidered the simplest way of modifyg them. In particular I was anxious find some scheme which did not inolve altered connections, the use of a oldering iron, or other special tools. was pleased to note that the press pe terminals used on this battery were entical with those of the original batry.

IMPLE

As it turned out it was delightfully asy. All I had to do was take hold the middle stack at the top, and fold back so that it lay end to end with e other two, the connections to both the ther stacks being such as to permit this ithout any trouble.

The two outside stacks had now to be ought together, but this was prevented itially by their connection to the two ess type fasteners mounted on a piece cardboard. A sharp pair of scissors lved that problem, by simply snipping e cardboard in two.

Finally, although the battery comrtment appeared to be completely inlated, I took the precaution of wrapng the battery in a layer of stout own paper. A suitable size plastic g, had there been one readily availble, might have been even better.

ION-TECHNICAL

The beauty of the whole scheme was at anybody could be taught the simple eration of modifying the battery, the ocess would take no more than a few inutes, and the only equipment reired was a pair of scissors from my dy's sewing basket.

All things considered, I felt a cerin amount of satisfaction at the sucss of my efforts.

Needless to say the owner was dehted with my efforts when she called a few days later. Quite apart from e personal satisfaction of solving the oblem, her gratitude seemed to make the trouble worthwhile.

(Of course, the service charge helped, o!)

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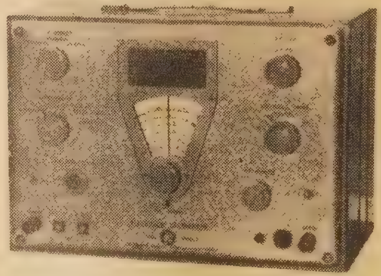
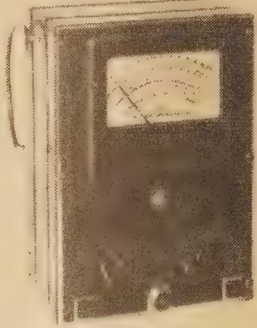
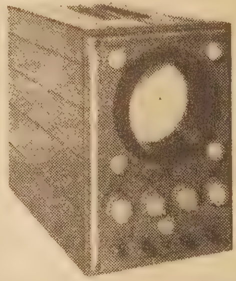
TEST EQUIPMENT for EFFICIENT TV SERVICING

TELEVISION CALIBRATOR TYPE A56057
Frequency range: 19 to 260 Mc.
Crystal frequency: 2.5 and 5.5 Mc.
RF Output: More than 100 mV.
Provision for vertical and horizontal bars.

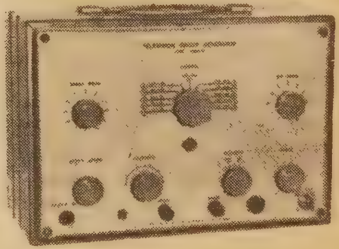




VOLTOHMYST TYPE A56010
DC volts: 0 to 1500 V.
AC. volts: 0 to 1500V.
Resistance: 0 to 1000M ohms.
DC. current: 0 to 1500 mA.
Accessories available for 30 kV and 250 Mc.



OSCILLOGRAPH TYPE A56031
Frequency range: DC to 1 Mc.
Time-base: 3 cycles to 30 Kc.
Sensitivity: 10 mV RMS/inch.



SWEEP GENERATOR TYPE A56036
RF frequency range: TV channels 1 to 10.
IF frequency range: 500 Kc to 50 Mc.
Sweep width: 0 to 10 Mc.
Provision for Oscillograph time-base and phasing control.

Brisbane and Northern Rivers readers, for further literature write to

CHANDLERS

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ANSWERS TO CORRESPONDENTS

B.Y. (Ascot Vale, Vic.) wants us to publish a circuit of a simple amplifier since he finds the circuits of the larger amplifiers too complicated.

A. We have published a number of such circuits in the past, including some in the Playmaster series. One which may interest you is the Low Cost Crystal Amplifier of February, 1957, but we have a number of even simpler designs if you prefer them. We suggest you take advantage of our postal service, give us as much information as possible concerning the use for which it is intended, type of pickup, etc., and we will do our best to select a suitable design from our files.

H.B. (Shenton Park, W.A.) is keen to build himself a TV set in anticipation of TV in Western Australia. However he is puzzled by the symbols and components associated with TV and wants to know if we can publish a list which would clarify these points for him.

A. We feel that your knowledge of radio in general is really not good enough to justify your tackling a TV set. Considering the amount of information, both theoretical and constructional, that has appeared in our magazine over the last couple of years, we feel that most enthusiasts should have been able to grasp the basic principles by now. In the circumstances we suggest that you will avoid a lot of expense and disappointment if you refrain from such a project until you have a better grasp of things.

M.R.D. (Bendigo, Vic.) is puzzled by an interaction effect between a crystal set and a normal receiver when working from the same aerial.

A. Without some knowledge of the crystal set circuit and, in particular, the type of volume control used, it would be impossible for us to offer much help. However, it is most likely that the use of a common aerial is a major factor, and that the crystal set is bringing about some form of loss in the aerial circuit, enough to affect signal strength. Separate aerials would be the obvious answer.

O.C. (Coorparoo, Q.) submits an article on the construction of wooden gramophone needles, which he claims have several advantages over other types.

A. Many thanks for your letter O.C. and the details you supply. This subject was dealt with quite extensively in the magazine some years ago, and the relative merits of various types of "needle" discussed. While there was undoubtedly some merit in the wooden needle in the early days of 78 records, we feel that there is no longer any real need for it. Modern microgroove records with sapphire or diamond styli represent a far better approach to the whole problem. So much so, that record wear almost has ceased to be a problem. In the circumstances we feel that there would be little interest in this subject on the part of other readers.

L.H. (Shell Harbour, N.S.W.) is a beginner to radio who asks a number of questions which are puzzling him.

A. If you are worried about the nature of your commercial power supply we suggest that your local power supply authority would be able to advise you. Otherwise, AC or DC may be recognised by applying it to either type of meter, by examination of the manner in which it is generated, or by observation of its wave form on a CRO. We would have to know more about the particular problem before we could advise in greater detail. We have described a number of small battery sets in the past but, once again, it would be easier to advise you if we knew exactly the job it was to do. A mixer in a superhet mixes the incoming signal with that generated in the local oscillator to produce a new (intermediate) frequency. The pins on an IF transformer which constitute a "pair" may be determined with an ohm meter. The primary and secondary are often identical, particularly in the "1st." However, the correct pins should be used in each case, and it is best to refer to the manufacturer's data to be quite sure.

H.A. (Geraldton, W.A.) writes to express his appreciation of the magazine and to send us a circuit of a simple transistor set he has made.

A. Many thanks for your letter H.A. and we are glad to learn that you find the magazine so interesting. Thanks also for the circuit, though we doubt that we will be able to use it in the "Reader Built It" section. The tendency at present is more toward the regenerative type of receiver for beginners, since it has so much more to offer for a given number of parts. We note also your suggestion regarding transistor amplifiers, and you may rest assured that we have a keen eye on this subject. Just as soon as the parts position is clarified and we can allocate the time we will have something to offer along these lines.

B.J.C. (Fairfield, Qld.) writes to tell us of his experience with a TRF receiver. He finds that the volume is best with the aerial lead wrapped around the grid lead of the second RF stage.

A. We would take this as an indication that the first RF stage is not operating at full efficiency. It would be a good idea to check the valve. This could be done simply by interchanging the first two 6U7-Gs. If this proves to be in order, we suggest that you check the voltages applied to the valve. They should correspond fairly closely with the voltages appearing on the second 6U7-G. Finally, if all is in order to this point, it is possible there is a fault in the aerial coil or the primary of the first RF coil. We assume that the alignment of the circuits is correct. With the set working properly, the overall RF gain may be sufficient to overload the detector and therefore we suggest that you retain the original RF gain control rather than substitute an audio control. If excessive volume is a problem on strong local stations, we suggest a 15,000 ohm wire wound potentiometer with the connection to the moving arm earthed. One of the end connections then goes to the cathode circuits of the RF amplifiers and the other end of the aerial terminal. At the minimum gain position then, the aer terminal will be shunted to ground thereby assi ing the gain reducing action of the cathode sistor.

D.G.W. (Tawa Flat, N.Z.) requests mc articles on tape recorders, particularly on the u of double track recording for stereo. He fe that this would be well within the capabiliti of the average experimenter, having himself do some experimental work in this field.

A. Your change of address has been noted a forwarded to the appropriate department. V agree with you in the matter of advertising son of which appears to be ambiguous.

Your suggestions and request for articles tape recorders and their use for stereo are note We have had these articles in mind for son time, however, with more pressing matters su as TV we have been forced to shelve our ide until a more suitable time.

S.P. (Warrimoo, N.S.W.) has connected a Ph lips Disc Jockey to a portable set on which has provided a pair of terminals. S.P. is surpris to find that the volume with the new pickup barely audible while when using an old sty magnetic pickup there is plenty of sound outpu S.P. ends by asking our advice on how to i crease the volume.

A. You have not indicated as to where an how you have adapted the pickup terminals c the portable and the difference in picku and the load impedances into which they fee may be responsible for the lack of volume. Se ondly the output of the crystal pickup may b much less than that of the old-style magneti Why not contact the makers of the portable an ask for their advice on the pickup connection

J.R.T.H. (Gladesville, N.S.W.) wishes to kno if it is possible to combine two receivers to giv stereo reproduction by using the audio chann of each. J.R.T.H. gives the type numbers of th two sets and, from the tone of his letter it seem that one of them is a small mantel set. Ou correspondent closes his letter by asking for ou advice in the matter of set sizes suitable for th job.

A. The audio sections of two receivers could b combined to form the basis of a stereo system but the adaption may not be easy for there ar several requirements to be observed. Firstly, th channels must be identical or at least, similar i output and sensitivity and, they must feed speaker of equal size and sensitivity. Secondly, som means of ganging the necessary controls such a the volume bass and treble, and thirdly a balanc control must be provided. All in all this may cal for a separate control unit such as the on described in the October 1958 issue. The volum controls in the sets may then be retained a preset controls to limit the signal fed to the grid of the first audio valves and prevent overload an consequent distortion.

Some knowledge and experience may be required to connect all these up in a sensible manner and to ensure their successful operation, an being a beginner, it may be necessary for you t call on the services of a more experienced person.

J.G. (address incomplete) forwards the circui of a single transistor receiver, using a ferrite ro aerial, which is reputed to be capable of operating a loudspeaker on local stations. The circui is from an American publication.

A. Our reaction is that the local station woul have to be very close, the speaker extremel sensitive and the listener prepared to place hi ear next to the speaker cone. In simpler terms we feel that the claim is very much exaggerated There are no magical qualities in the circui you enclose and in fact, if anything, it is out o date since there is no regeneration included. Th single transistor receiver described in the December, 1958, issue, for which we claim headphon results only would probably work at least as wel while the 2-transistor set from the January issu would be even better. We are planning a number of small transistor receivers including th simplest possible circuits for satisfactory speake results. It is usual to include your full nam and address as evidence of good faith. These ar not necessarily published.

F.S. (Glen Iris, Vic.) wishes to use the typ 7C7 valve in place of the 6J7 also type 6F6 i place of the 807 in the Senior Radiogram.

A. The 7C7 valve is sufficiently close in it characteristics to the 6J7 to enable the change to be made without any circuit modifications. I will only be necessary to use a loctal socket i place of the usual octal. The 6F6 valve, on the other hand differs from the 807 and some change will be required. Unless you are capable of calculating the necessary values from characteristic given in valve data books we do not suggest tha you attempt to make such changes. In any cas the available power output would be very much less with the 6F6's.

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Mr Paul W. Butler, 1 Darley Road, Randwick, has some odd items of radio equipment he is willing to make available free of charge to radio beginners. Mr Butler asks particularly that the callers should contact him in person only, and at weekends only.

ANSWERS TO CORRESPONDENTS

V.P. (Perth, W.A.) has built the Transporta using a slightly larger case and a 6in speaker. is very happy with the result, and has been that it performs better than at least one mercial set. He wants to know if it is pos to use the set with a car aerial and from car electrical system.

. Many thanks for your report on this set we are glad to learn that you have found o satisfactory. It should be possible to fit rimary coil to the rod aerial, and this point overed in the February, 1959, issue. The set function with only a six-volt supply, but we tate to recommend operation from the car ery. While the voltage is sometimes higher the nominal six, this is unlikely to be high ugh for long enough to give satisfactory oper n. All things considered, we regard it as good cy to avoid this form of operation. There ld seem to be little point in increasing the lback, since the sensitivity would drop sub tially from this point on with only marginal rovement in the reproduction. Since the n limitation would involve the speaker and ctive baffling area, it would seem likely that are getting the best results possible from a of this size. Some shielding would be neces to avoid ignition interference.

.B. (Forbes, N.S.W.) sends in a query regard the impedance of headphones and suggests we may answer it on the Here's Your Answer. n, page.

. Yes, we feel that your query is most suited the Answer Tom page and are filing it for ible future use.

.G.H. (Parkes, N.S.W.) has two speakers with hm and 3.7 ohm voice coils, and wants to w if these can be connected in series for use a 15 ohm transformer secondary.

.: This arrangement, plus some resistance as suggest, would certainly provide a correct for the output stage, but would be rather tisfactory in regard to the speaker perform . This would be due to the uneven distri on of power in the two speakers, which, ther with the naturally lower efficiency of smaller speaker, would probably result in a ceable difference in level from the two speak to the detriment of the smaller one.

.C.F. (Caloundra, Q.) is obviously puzzled by y aspects of stereophonic sound, and asks a ber of questions about it.

. It is not correct to say the two channels recorded in the vertical and horizontal planes, although this idea was used in the early experimental stages. Present practice is to record the two channels at 45 degrees from the vertical and 90 degrees from each other. This subject has been covered in considerable detail in articles in the magazine in the last few months, and we would refer you to these for further information. Most back copies will be available if required. It is normal practice to have identical channels and speaker systems, though a certain amount of unbalance can be tolerated. We suggest that equipment which you have heard would have to be appreciably out of balance for this to be so noticeable on ordinary program material. As with the articles on stereo, we would refer you to several stereo amplifiers which have been described in recent issues, including one in the January issue. Any information previously published concerning speakers, enclosures, cross-over networks, etc., for single channel systems would apply equally to the absolute enthusiast who demands "two of everything" in the highest possible quality.

A.J.R. (Adelaide, S.A.) is keen to build the Amateur Tuner of February, 1958, but wants to know if a circuit is available using transistors in place of valves, or if such a circuit is likely to be described in the near future.

A. Sorry, A.J.R., but we must emphasise again that transistors cannot be looked upon as straight-out substitutes for valves, automatically available for any valve circuit one cares to nominate. Transistors for use at the frequencies involved are very expensive and not very readily available in this country at the present time. In addition, a lot of design work would be required before something like the tuner you envisage could be produced. It is impossible for us to forecast the likely advent of such a design, since we must wait at least until there are ample stocks of transistors available, at a moderate cost, and until a suitable design can be worked out. In the circumstances, we feel that you would be better advised to go ahead with the current design.

R.L. (Newtown, N.S.W.) forwards some information on a modulated oscillator for receiver alignment, using transistors, which he has constructed. The original idea came from an overseas publication, but he feels that it could well be of interest to R.T. and H. readers.

A. We agree that many readers would be interested in an alignment oscillator of this type and will keep your letter aside for possible use in the "Reader Built It" feature.

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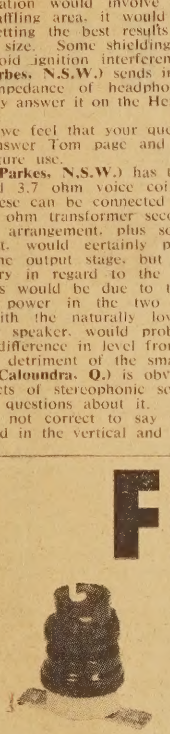

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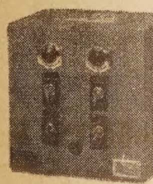

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LECTRONICS BRINGS IGHT TO THE BLIND

(Continued from Page 23)

She was placed in a sitting position, en the photoelectric cell and told to be for the light.

"There it is! It's there on my right . . over there. Right there!" She ished with an emphatic shake of the otocell as she pointed it squarely at lamp.

"Now it's on my left. Now it's there . right straight ahead!"

The drama was not yet over. Betty s given a day of rest, after which apparatus was suspended in a oulder-bag, still attached, of course, the tiny wires protruding from the ndage in the back of her head. She s on her own! Her task now was to lk through an obstacle course conting of lamps strategically placed out a large room.

OUND THE WINDOWS

Betty was also to find the windows perceiving daylight.

It is almost an anti-climax to report at Betty succeeded magnificently in complishing these objectives. Her al triumph came, perhaps, when she rceived the candlelight on her birthy cake and accurately blew the ndles out.

But we realised that our experiment, ough representing a milestone in edical history, was only a primitive ginning. To be sure, the initial experient has been improved upon. Rently new and smaller wires have been planted in Betty's brain.

By attaching two square-wave generars simultaneously to two pairs of wires tty could perceive, through two sets photocells, varying patterns of light.

These patterns were altered in ways at we have yet to explain when the uare waves were rapidly changed to e waves and back again.

Such patterns constitute a step toards perception of images and shapes, hich we believe we shall eventually tain as we refine our surgical techques, improve our electronic scanners d, above all, learn a great deal more out the physiology of vision.

In the immediate future, for instance, e plan to insert not two wires, not ur, but several hundred. Their size ill be almost microscopic, hence there ill be no irritation of the brain.

O WOUND

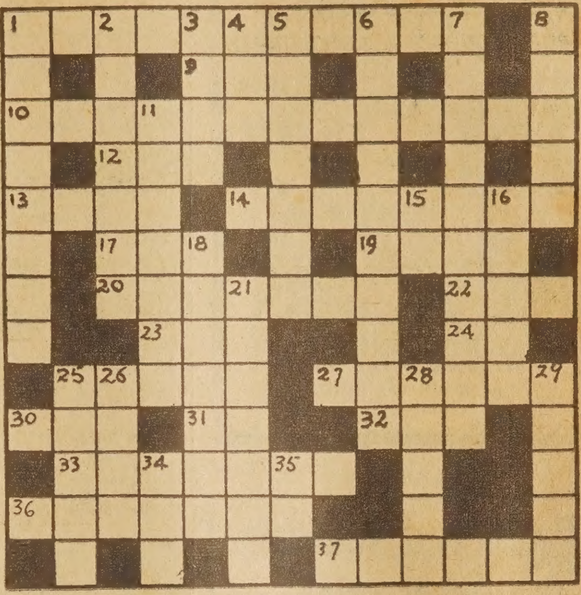
Furthermore, no wound will remain we shall bury the wires permanently, low the skull and skin to heal and ansmit the required current by inducon through a solenoid hidden in the afts of eye glasses. We are now esigning various miniaturised devices to ick up visual currents, ranging from ny photosensitive image screens to odified sonar units.

The visual impressions obtained by the lind, in the not too distant future, will our opinion approximate true vision —all through an apparatus as simple nd inconspicuous as a hearing aid.

There are those who say our project annot be successfully completed. Unortunately, many with sight have no ision.

But many with vision have no sight, and it is from these—from among the brave Bettys who will continue to volunteer for our experiments—that our faith, our hope and **their** help will spring. —("Radio Electronics.")

THE R., T.V. & H. CROSSWORD No. 58



ACROSS

1. Measured with reference to a standard dipole (2 words).
9. An infinitely long period.
10. Connections to the input of a power transformer (2 words).
12. An instrument for rowing boats.
13. Wooden dowels.
14. Eight more than 10.
17. To add.
19. A measure of length.
20. Genuine.
22. Unit of work.
23. Prefix meaning new.
24. Volume indicator (abbrev.).
25. Point of belief.
27. Girl's name.
30. Her Royal Highness (abbrev.).
31. Indicative of the verb to be.
32. Calibrate (abbrev.).
33. Instrument for measuring electric current.
36. Abused.
37 Pure charcoal.

DOWN

1. A term used to denote current flow.
2. Three element valves.
3. Close.
4. Introduces the second clause of a negative proposition.
5. Some period.
6. Science of numbers.
7. Same as loudness level (2 words).
8. Character from Oliver Twist.
11. Limiting the printing of a negative.
15. The symbol for titanium.
16. Weird.
18. Foes.
21. Sailed along.
25. To filter.
26. Electrical units.
28. A stratum.
29. Old-type rectifier valve.
34. Slang for silent.
35. Editor (abbrev.).

Solution and further crossword next month

LET'S BUY AN ARGUMENT

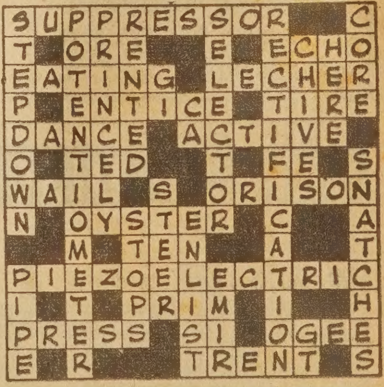
(Continued from Page 99)

is often stronger than logic and even stronger than the purse strings.

Another point is that the idea ignores one very important factor — and here we could join issue with friend Briggs—namely, the dissimilar "colouration" of different speakers on the two channels.

Voices can change appreciably in timbre when moving from one to the other; supposedly identical sounds from both speakers can be quite different; a peak in one where a trough exists in the other can produce an apparent jump in the sound source.

Last month's solution



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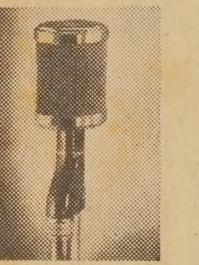

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FOR SALE: Every copy of R. and H. from vol. 1, No. 1 (April, 1939) to vol. 19, No 9 (Dec., 1957). Second set volumes 1 to 15. All bound in volumes. Sell as 2 complete sets, not in individual volumes. **31 Garfield St., Wentworthville, N.S.W. YA8266.**

SELL: C.R.O. case, 5in standard, 5BPI and socket, 2000v. R.F. power supply, 6.3V trans. 2500V ins. £10. Power supply, 450V. 250 mA. £10. 3 transformers, 6.3V. 3 amps. 30/. **155 Riversdale Rd., Camberwell, Melbourne. WF7448.**

SELL: Used, all tested, 6BL8, 6BX6, 6BM8, 12AU7, 6CW7, 6R3, 6N3, 6CM5, 6AX4, 6CU6, 1S2, each 6/6. Post free. **Waverly Trading, Box 66, P.O., William St., Sydney.**

SELL: 5 BPI's 32/6 ea. Back issues R., T.V. and H. from 1943 to present. £15 lot. Also some spares. Free delivery Sydney or near. **86 Campbell Hill Rd., Chester Hill, Sydney. YJ4543.**

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SELL: T.V parts. I.F. amplifier strip wired, with 6 valves from "Rebecca" set, £3. 12in C.R.T., VCR511A 50/, both unused. Palec MCA AC/DC multimeter £8. **1 Caroline St., Earlwood. UW6704.**

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